Bioorthogonal antigens as tool for investigation of antigen processing and presentation

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Bibliography

1. Daphne M van Elsland, Erik Bos, Wouter de Boer, Herman S Overkleeft, Abraham J Koster, and Sander I van Kasteren. Detection of bioorthogonal groups by correlative light and electron microscopy allows imaging of degraded bacteria in phagocytes. *Chemical Science*, 7(1):752–758, 2016.

2. Kristi L Kiick, Eliana Saxon, David A Tirrell, and Carolyn R Bertozzi. Incorporation of azides into recombinant proteins for chemoselective modification by the staudinger ligation. *Proceedings of the National Academy of Sciences*, 99(1):19–24, 2002.

3. Jeremy M Baskin, Jennifer A Prescher, Scott T Laughlin, Nicholas J Agard, Pamela V Chang, Isaac A Miller, Anderson Lo, Julian A Codelli, and Carolyn R Bertozzi. Copper-free click chemistry for dynamic in vivo imaging. *Proceedings of the National Academy of Sciences*, 104(43):16793–16797, 2007.

4. Jonathan D Jones, B JoNell Hamilton, and William FC Rigby. Brief report: Anti-carbamylated protein antibodies in rheumatoid arthritis patients are reactive with specific epitopes of the human fibrinogen β-chain. *Arthritis & Rheumatology*, 69 (7):1381–1386, 2017.

5. Valeria Manganelli, Serena Recalchi, Antonella Capozzi, Gloria Riitano, Vincenzo Mattei, Agostina Longo, Manuela Di Franco, Cristiano Alessandri, Michele Bombardieri, Guido Valesini, Roberta Misasi, Tina Garofalo, and Maurizio Sorice. Autophagy induces protein carbamylation in fibroblast-like synoviocytes from patients with rheumatoid arthritis. *Rheumatology*, 57(11):2032–2041, 2018.

6. Charles A Janeway Jr, Paul Travers, Mark Walport, and Mark J Shlomchik. Pathogens have evolved various means of evading or subverting normal host defenses. In *Immunobiology: The Immune System in Health and Disease. 5th edition*. Garland Science, 2001.

7. Troels Lillebaek, Asger Dirksen, Inga Baess, Benedicte Strunge, Vibeke Ø Thomsen, and Åse B Andersen. Molecular evidence of endogenous reactivation of mycobacterium tuberculosis after 33 years of latent infection. *The Journal of Infectious Diseases*, 185(3):401–404, 2002.

8. Mika Paldanius, Aini Bloigu, Marianne Alho, Maija Leinonen, and Pekka Saikku. Prevalence and persistence of Chlamydia pneumoniae antibodies in healthy laboratory personnel in Finland. *Clinical and Diagnostic Laboratory Immunology*, 12(5): 654–659, 2005.

9. Eric Vivier and Bernard Malissen. Innate and adaptive immunity: specificities and signaling hierarchies revisited. *Nature Immunology*, 6(1):17, 2005.

10. Martin F Flajnik and Masanori Kasahara. Origin and evolution of the adaptive immune system: genetic events and selective pressures. *Nature Reviews Genetics*, 11(1):47, 2010.

11. Jenni Punt. Adaptive immunity: T cells and cytokines. In *Cancer Immunotherapy*, pages 41–53. Elsevier, 2013.

12. William B Bean. The clonal selection theory of acquired immunity. *American Medical Association Archives of Internal Medicine*, 105(6):973–974, 06 1960.

13. Manfred B Lutz and Gerold Schuler. Immature, semi-mature and fully mature dendritic cells: which signals induce tolerance or immunity? *Trends in Immunology*, 23(9):445–449, 2002.

14. Gabrielle T Belz, Georg MN Behrens, Chris M Smith, Jacques FAP Miller, Claerwen Jones, Kristina Lejon, C Garrison Fathman, Scott N Mueller, Ken Shortman, Francis R Carbone, and William R Heath. The CD8a^+ dendritic cell is responsible for inducing peripheral self-tolerance to tissue-associated antigens. *Journal of Experimental Medicine*, 196(8):1099–1104, 2002.

15. Kajsa Wing and Shimon Sakaguchi. Regulatory T cells exert checks and balances on self tolerance and autoimmunity. *Nature Immunology*, 11(1):7, 2010.

16. Nina S Cauchon, Shirley Oghamian, Soraya Hassanpour, and Michael Abernathy. Innovation in chemistry, manufacturing, and controls–a regulatory perspective from industry. *Journal of Pharmaceutical Sciences*, 2019.

17. Charles A Janeway Jr. The immune system evolved to discriminate infectious nonself from noninfectious self. *Immunology Today*, 13(1):11–16, 1992.

18. Ruslan Medzhitov and Charles A Janeway Jr. Innate immune recognition and control of adaptive immune responses. In *Seminars in Immunology*, volume 10, pages 351–353. Elsevier, 1998.

19. Charles A Janeway Jr and Kim Bottomly. Signals and signs for lymphocyte responses. *Cell*, 76(2):275–285, 1994.

20. Richard R Hardy and Kyoko Hayakawa. B cell development pathways. *Annual Review of Immunology*, 19(1):595–621, 2001.

21. Stefano Casola, Kevin L Otipoby, Marat Alimzhanov, Sibille Humme, Nathalie Uyttersprot, Jeffery L Kutok, Michael C Carroll, and Klaus Rajewsky. B cell receptor signal strength determines B cell fate. *Nature Immunology*, 5(3):317, 2004.

22. Christopher C Goodnow, Carola G Vinuesa, Katrina L Randall, Fabienne Mackay, and Robert Brink. Control systems and decision making for antibody production. *Nature Immunology*, 11(8):681, 2010.

23. Claerwen M Jones, Richard A Lake, Jonathan R Lamb, and Alex Faith. Degeneracy of T cell receptor recognition of an influenza virus hemagglutinin epitope restricted by HLA-DQ and-DR class II molecules. *European Journal of Immunology*, 24(5): 1137–1142, 1994.

24. Charles A Janeway Jr. Ligands for the T-cellreceptor: hard times for avidity models. *Immunology Today*, 16(5):223–225, 1995.

25. Thierry Boon, Pierre G Coulie, and Benoît Van den Eynde. Tumor antigens recognized by T cells. *Immunology Today*, 18(6):267–268, 1997.

26. Jia-huai Wang and Ellis L Reinherz. Structural basis of T cell recognition of peptides bound to MHC molecules. *Molecular Immunology*, 38(14):1039–1049, 2002.

27. Marina Cella, Federica Sallusto, and Antonio Lanzavecchia. Origin, maturation and antigen presenting function of dendritic cells. *Current Opinion in Immunology*, 9(1):10–16, 1997.

28. Jacques Banchereau and Ralph M Steinman. Dendritic cells and the control of immunity. *Nature*, 392(6673):245, 1998.

29. Taku Kambayashi and Terri M Laufer. Atypical MHC class II-expressing antigen-presenting cells: can anything replace a dendritic cell? *Nature Reviews Immunology*, 14(11):719, 2014.

30. Jonathan Sprent. Antigen-presenting cells: professionals and amateurs. *Current Biology*, 5(10):1095–1097, 1995.

31. Bali Pulendran. Immune activation: death, danger and dendritic cells. *Current Biology*, 14(1):R30–R32, 2004.

32. Sandra Georgina Solano-Gálvez, Sonia Margarita Tovar-Torres, María Sofía Tron-Gómez, Ariane Estrella Weiser-Smeke, Diego Abelardo Álvarez-Hernández, Giorgio Alberto Franyuti-Kelly, Mijail Tapia-Moreno, Antonio Ibarra, Laila Gutiérrez-Kobeh, and Rosalino Vázquez-López. Human dendritic cells: ontogeny and their subsets in health and disease. *Medical Sciences*, 6(4):88, 2018.

33. Alfonso Martín-Fontecha, Antonio Lanzavecchia, and Federica Sallusto. *Dendritic cell migration to peripheral lymph nodes*. Springer, 2009.

34. Ira Mellman, Shannon J Turley, and Ralph M Steinman. Antigen processing for amateurs and professionals. *Trends in Cell Biology*, 8(6):231–237, 1998.

35. Ralph M Steinman. The dendritic cell system and its role in immunogenicity. *Annual Review of Immunology*, 9(1):271–296, 1991.

36. Linda Wooldridge, Julia Ekeruche-Makinde, Hugo A van den Berg, Anna Skowera, John J Miles, Mai Ping Tan, Garry Dolton, Mathew Clement, Sian Llewellyn-Lacey, David A Price, Mark Peakman, and Andrew K Sewell. A single autoimmune T cell receptor recognizes more than a million different peptides. *Journal of Biological Chemistry*, 287(2):1168–1177, 2012.

37. Charles A Janeway Jr, Paul Travers, Mark Walport, and Mark J Shlomchik. *The major histocompatibility complex and its functions*. Garland Science, 2001.

38. Janice S Blum, Pamela A Wearsch, and Peter Cresswell. Pathways of antigen processing. *Annual Review of Immunology*, 31:443–473, 2013.

39. Olivier P Joffre, Elodie Segura, Ariel Savina, and Sebastian Amigorena. Cross-presentation by dendritic cells. *Nature Reviews Immunology*, 12(8):557, 2012.

40. Louise J Young, Nicholas S Wilson, Petra Schnorrer, Anna Proietto, Toine Ten Broeke, Yohei Matsuki, Adele M Mount, Gabrielle T Belz, Meredith O'keeffe, Mari Ohmura-Hoshino, Satoshi Ishido, Willem Stoorvogel, Heath William R, Ken Shortman, and Jose A Villadangos. Differential MHC class II synthesis and ubiquitination confers distinct antigen-presenting properties on conventional and plasmacytoid dendritic cells. *Nature Immunology*, 9(11):1244, 2008.

41. Jacques Neefjes, Marlieke LM Jongsma, Petra Paul, and Oddmund Bakke. Towards a systems understanding of MHC class I and MHC class II antigen presentation. *Nature Reviews Immunology*, 11(12):823, 2011.

42. Clifford V Harding and Emil R Unanue. Quantitation of antigen-presenting cell MHC class II/peptide complexes necessary for T-cell stimulation. *Nature*, 346 (6284):574, 1990.

43. Jonathan W Yewdell and Brian P Dolan. Immunology: Cross-dressers turn on T cells. *Nature*, 471(7340):581, 2011.

44. Sébastien Apcher, Rodrigo Prado Martins, and Robin Fahraeus. The source of MHC class I presented peptides and its implications. *Current Opinion in Immunology*, 40:117–122, 2016.

45. Michael D Cahalan and George A Gutman. The sense of place in the immune system. *Nature Immunology*, 7(4):329, 2006.

46. Marie-Hélène Fortier, Étienne Caron, Marie-Pierre Hardy, Grégory Voisin, Sébastien Lemieux, Claude Perreault, and Pierre Thibault. The MHC class I peptide repertoire is molded by the transcriptome. *Journal of Experimental Medicine*, 205 (3):595–610, 2008.

47. Jennifer D Stone, Adam S Chervin, and David M Kranz. T-cell receptor binding affinities and kinetics: impact on T-cell activity and specificity. *Immunology*, 126 (2):165–176, 2009.

48. E Yvonne Jones, Lars Fugger, Jack L Strominger, and Christian Siebold. MHC class II proteins and disease: a structural perspective. *Nature Reviews Immunology*, 6(4):271, 2006.

49. Mark A Atkinson and George S Eisenbarth. Type 1 diabetes: new perspectives on disease pathogenesis and treatment. *The Lancet*, 358(9277):221–229, 2001.

50. Bernhard Hemmer, Juan J Archelos, and Hans-Peter Hartung. New concepts in the immunopathogenesis of multiple sclerosis. *Nature Reviews Neuroscience*, 3 (4):291, 2002.

51. Ravi Hingorani, Joanita Monteiro, Richard Furie, Elliot Chartash, Cristina Navarrete, Robert Pergolizzi, and Peter K Gregersen. Oligoclonality of Vβ3 TCR chains in the CD8^{+} T cell population of rheumatoid arthritis patients. *The Journal of Immunology*, 156(2):852–858, 1996.

52. Cornelis JM Melief, Sjoerd H Van Der Burg, Rene EM Toes, Ferry Ossendorp, and Rienk Offringa. Effective therapeutic anticancer vaccines based on precision guiding of cytolytic T lymphocytes. *Immunological Reviews*, 188(1):177–182, 2002.

53. Sjoerd H van Der Burg and Cornelis JM Melief. Therapeutic vaccination against human papilloma virus induced malignancies. *Current Opinion in Immunology*, 23 (2):252–257, 2011.

54. Sjoerd H van der Burg, Ramon Arens, Ferry Ossendorp, Thorbald van Hall, and Cornelis JM Melief. Vaccines for established cancer: overcoming the challenges posed by immune evasion. *Nature Reviews Cancer*, 16(4):219, 2016.

55. Ander Urruticoechea, Ramon Alemany, Josep Balart, Augusto Villanueva, Francesc Vinals, and Gabriel Capella. Recent advances in cancer therapy: an overview. *Current Pharmaceutical Design*, 16(1):3–10, 2010.

56. Nicholas McGranahan, Andrew JS Furness, Rachel Rosenthal, Sofie Ramskov, Rikke Lyngaa, Sunil Kumar Saini, Mariam Jamal-Hanjani, Gareth A Wilson, Nicolai J Birkbak, Crispin T Hiley, Thomas B K Watkins, Seema Shafi, Nirupa Murugaesu, Richard Mitter, Ayse U Akarca, Joseph Linares, Teresa Marafioti, Jake Y Henry, Eliezer M Van Allen, Diana Miao, Bastian Schilling, Dirk Schadendorf, Levi A Garraway, Vladimir Makarov, Naiyer A Rizvi, Alexandra Snyder, Matthew D Hellmann, Taha Merghoub, Jedd D Wolchok, Sachet A Shukla, Catherine J Wu, Karl S Peggs, Timothy A Chan, Sine R Hadrup, Sergio A Quezada, and Charles Swanton. Clonal neoantigens elicit T cell immunoreactivity and sensitivity to immune checkpoint blockade. *Science*, 351(6280):1463–1469, 2016.

57. Özlem Türeci, Mathias Vormehr, Mustafa Diken, Sebastian Kreiter, Christoph Huber, and Ugur Sahin. Targeting the heterogeneity of cancer with individualized neoepitope vaccines. *Clinical Cancer Research*, 22(8):1885–1896, 2016.

58. Ugur Sahin, Evelyna Derhovanessian, Matthias Miller, Björn-Philipp Kloke, Petra Simon, Martin Löwer, Valesca Bukur, Arbel D Tadmor, Ulrich Luxemburger, Barbara Schrörs, Tana Omokoko, Mathias Vormehr, Christian Albrecht, Anna Paruzynski, Andreas N Kuhn, Janina Buck, Sandra Heesch, Katharina H Schreeb, Felicitas Müller, Inga Ortseifer, Isabel Vogler, Eva Godehardt, Sebastian Attig, Richard Rae, Andrea Breitkreuz, Claudia Tolliver, Martin Suchan, Goran Martic, Alexander Hohberger, Patrick Sorn, Jan Diekmann, Janko Ciesla, Olga Waksmann, Alexandra-Kemmer Brück, Meike Witt, Martina Zillgen, Andree Rothermel, Barbara Kasemann, David Langer, Stefanie Bolte, Mustafa Diken, Sebastian Kreiter, Romina Nemecek, Christoffer Gebhardt, Stephan Grabbe, Christoph Höller, Jochen Utikal, Christoph Huber, Carmen Loquai, and Özlem Türeci. Personalized RNA mutanome vaccines mobilize poly-specific therapeutic immunity against cancer. *Nature*, 547(7662):222, 2017.

59. Olivera J Finn and Hans-Georg Rammensee. Is it possible to develop cancer vaccines to neoantigens, what are the major challenges, and how can these be overcome? Neoantigens: nothing new in spite of the name. *Cold Spring Harbor Perspectives in Biology*, 10(11):a028829, 2018.

60. Roberto S Accolla, Luigi Buonaguro, Cornelis Melief, Hans-George Rammensee, and Michal Bassani-Sternberg. Novel strategies for anti-tumor vaccines. *Frontiers in Immunology*, 10, 2019.

61. Daniel L Stoler, Neng Chen, Mark Basik, Morton S Kahlenberg, Miguel A Rodriguez-Bigas, Nicholas J Petrelli, and Garth R Anderson. The onset and extent of genomic instability in sporadic colorectal tumor progression. *Proceedings of the National Academy of Sciences*, 96(26):15121–15126, 1999.

62. Ton N Schumacher and Robert D Schreiber. Neoantigens in cancer immunotherapy. *Science*, 348(6230):69–74, 2015.

63. Mahesh Yadav, Suchit Jhunjhunwala, Qui T Phung, Patrick Lupardus, Joshua Tanguay, Stephanie Bumbaca, Christian Franci, Tommy K Cheung, Jens Fritsche, Toni Weinschenk, Zora Modrusan, Ira Mellman, Jennie R Lill, and Lélia Delamarre. Predicting immunogenic tumour mutations by combining mass spectrometry and exome sequencing. *Nature*, 515(7528):572, 2014.

64. Mark Yarchoan, Burles A Johnson III, Eric R Lutz, Daniel A Laheru, and Elizabeth M Jaffee. Targeting neoantigens to augment antitumour immunity. *Nature Reviews Cancer*, 17(4):209, 2017.

65. Edward F Fritsch, Mohini Rajasagi, Patrick A Ott, Vladimir Brusic, Nir Hacohen, and Catherine J Wu. HLA-binding properties of tumor neoepitopes in humans. *Cancer Immunology Research*, 2(6):522–529, 2014.

66. Patrick A Ott, Zhuting Hu, Derin B Keskin, Sachet A Shukla, Jing Sun, David J Bozym, Wandi Zhang, Adrienne Luoma, Anita Giobbie-Hurder, Lauren Peter, Christina Chen, Oriol Olive, Todd A Carter, Shuqiang Li, David J Lieb, Thomas Eisenhaure, Evisa Gjini, Jonathan Stevens, William J Lane, Indu Javeri, Kaliappanadar Nellaiappan, Andres M Salazar, Heather Daley, Michael Seaman, Elizabeth I Buchbinder, Charles H Yoon, Maegan Harden, Niall Lennon, Stacey Gabriel, Scott J Rodig, Dan H Barouch, Jon C Aster, Gad Getz, Kai Wucherpfennig, Donna Neuberg, Jerome Ritz, Eric S Lander, Edward F Fritsch, Nir Hacohen, and Catherine J Wu. An immunogenic personal neoantigen vaccine for patients with melanoma. *Nature*, 547(7662):217, 2018.

67. Jacques Banchereau and Karolina Palucka. Immunotherapy: Cancer vaccines on the move. *Nature Reviews Clinical Oncology*, 15(1):9, 2018.

68. Derin B Keskin, Annabelle J Anandappa, Jing Sun, Itay Tirosh, Nathan D Mathewson, Shuqiang Li, Giacomo Oliveira, Anita Giobbie-Hurder, Kristen Felt, Evisa Gjini, Sachet A Shukla, Zhuting Hu, Letitia Li, Phuong M Le, Rosa L Allesøe, Alyssa R Richman, Monica S Kowalczyk, Sara Abdelrahman, Jack E Geduldig, Sarah Charbonneau, Kristine Pelton, J Bryan Iorgulescu, Liudmila Elagina, Wandi

Zhang, Oriol Olive, Christine McCluskey, Lars R Olsen, Jonathan Stevens, William J Lane, Andres M Salazar, Heather Daley, Patrick Y Wen, E Antonio Chiocca, Maegan Harden, Niall J Lennon, Gabriel Stacey, Gad Getz, Eric S Lander, Aviv Regev, Jerome Ritz, Donna Neuberg, Scott J Rodig, Keith L Ligon, Mario L Suvá, Kai W Wucherpfennig, N Hacohen, Edward F Fritsch, Kenneth J Livak, Patrick A Ott, Catherine J Wu, and David A Reardon. Neoantigen vaccine generates intratumoral T cell responses in phase Ib glioblastoma trial. *Nature*, 565(7738):234, 2019.

69. Patrick A Ott, Siwen Hu-Lieskovan, Bartosz Chmielowski, Ramaswamy Govindan, Aung Naing, Nina Bhardwaj, Kim Margolin, Mark M Awad, Matthew D Hellmann, Jessica J Lin, Terence Friedlander, Meghan E Bushway, Kristen N Balogh, Tracey E Sciuto, Victoria Kohler, Samantha J Turnbull, Rana Besada, Riley R Curran, Benjamin Trapp, Julian Scherer, Asaf Poran, Dewi Harjanto, Dominik Barthelme, Ying Sonia Ting, Jesse Z Dong, Yvonne Ware, Yuting Huang, Zhengping Huang, Amy Wanamaker, Lisa D Cleary, Melissa A Moles, Kelledy Manson, Joel Greshock, Zakaria S Khondker, Ed Fritsch, Michael S Rooney, Mark DeMario, Richard B Gaynor, and Lakshmi Srinivasan. A phase Ib trial of personalized neoantigen therapy plus anti-PD-1 in patients with advanced melanoma, non-small cell lung cancer, or bladder cancer. *Cell*, 183(2):347–362, 2020.

70. Satyajit Mayor and Richard E Pagano. Pathways of clathrin-independent endocytosis. *Nature Reviews Molecular Cell Biology*, 8(8):603, 2007.

71. Delphyne Descamps, Mathieu Le Gars, Viviane Balloy, Diane Barbier, Sophia Maschalidi, Mira Tohme, Michel Chignard, Reuben Ramphal, Bénédicte Manoury, and Jean-Michel Sallenave. Toll-like receptor 5 (TLR5), IL-1beta secretion, and asparagine endopeptidase are critical factors for alveolar macrophage phagocytosis and bacterial killing. *Proceedings of the National Academy of Sciences*, 109 (5):1619–1624, 2012.

72. Michele A West, Alan R Prescott, Eeva-Liisa Eskelinen, Anne J Ridley, and Colin Watts. Rac is required for constitutive macropinocytosis by dendritic cells but does not control its downregulation. *Current Biology*, 10(14):839–848, 2000.

73. Gary J Doherty and Harvey T McMahon. Mechanisms of endocytosis. *Annual Review of Biochemistry*, 78:857–902, 2009.

74. Lisa K Denzin and Peter Cresswell. HLA-DM induces CLIP dissociation from MHC class II $\alpha\beta$ dimers and facilitates peptide loading. *Cell*, 82(1):155–165, 1995.

75. Peter Cresswell, Naveen Bangia, Tobias Dick, and Gundo Diedrich. The nature of the MHC class I peptide loading complex. *Immunological Reviews*, 172(1):21–28, 1999.

76. Christian Schölz and Robert Tampé. The peptide-loading complex–antigen translocation and MHC class I loading. *Biological Chemistry*, 390(8):783–794, 2009.

77. J Magarian Blander. Regulation of the cell biology of antigen cross-presentation. *Annual Review of Immunology*, 36:717–753, 2018.

78. Charles A Janeway, Paul Travers, Mark Walport, and Mark J Shlomchik. *Immunobiology: the immune system in health and disease.* Garland Science New York, 2005.

79. Lesley Ann Smyth, Nicola Harker, Wayne Turnbull, Haytham El-Doueik, Linda Klavinskis, Dimitris Kioussis, Giovanna Lombardi, and Robert Lechler. The relative efficiency of acquisition of MHC: peptide complexes and cross-presentation depends on dendritic cell type. *The Journal of Immunology*, 181(5):3212–3220, 2008.

80. Robert H Pierce, Jean S Campbell, Sara I Pai, Joshua D Brody, and Holbrook EK Kohrt. In-situ tumor vaccination: bringing the fight to the tumor. *Human Vaccines & Immunotherapeutics*, 11(8):1901–1909, 2015.

81. Fiorella Kotsias, Eik Hoffmann, Sebastian Amigorena, and Ariel Savina. Reactive oxygen species production in the phagosome: impact on antigen presentation in dendritic cells. *Antioxidants & Redox Signaling*, 18(6):714–729, 2013.

82. Frans Bianchi, Johannes Textor, and Geert van den Bogaart. Transmembrane helices are an overlooked source of major histocompatibility complex class I epitopes. *Frontiers in Immunology*, 8:1118, 2017.

83. Colin Watts. The exogenous pathway for antigen presentation on major histocompatibility complex class II and CD1 molecules. *Nature Immunology*, 5(7):685, 2004.

84. Laura B Pritzker, Shashikant Joshi, Jessica J Gowan, George Harauz, and Mario A Moscarello. Deimination of myelin basic protein. 1. Effect of deimination of arginyl residues of myelin basic protein on its structure and susceptibility to digestion by cathepsin D. *Biochemistry*, 39(18):5374–5381, 2000.

85. Hugues J-P Ryser. Uptake of protein by mammalian cells: An underdeveloped area: The penetration of foreign proteins into mammalian cells can be measured and their functions explored. *Science*, 159(3813):390–396, 1968.

86. Michele A West, Antony N Antoniou, Alan R Prescott, Toshifumi Azuma, David J Kwiatkowski, and Colin Watts. Membrane ruffling, macropinocytosis and antigen presentation in the absence of gelsolin in murine dendritic cells. *European Journal of Immunology*, 29(11):3450–3455, 1999.

87. Ewoud Bernardus Compeer, Thijs Willem Hendrik Flinsenberg, Susanna Geertje van der Grein, and Marianne Boes. Antigen processing and remodeling of the endosomal pathway: requirements for antigen cross-presentation. *Frontiers in Immunology*, 3:37, 2012.

88. Richard A Hopkins and John E Connolly. The specialized roles of immature and mature dendritic cells in antigen cross-presentation. *Immunologic Research*, 53 (1-3):91–107, 2012.

89. Elinor Erez, Deborah Fass, and Eitan Bibi. How intramembrane proteases bury hydrolytic reactions in the membrane. *Nature*, 459(7245):371, 2009.

90. Bénédicte Manoury, Eric W Hewitt, Nick Morrice, Pam M Dando, Alan J Barrett, and Colin Watts. An asparaginyl endopeptidase processes a microbial antigen for class II MHC presentation. *Nature*, 396(6712):695, 1998.

91. Sean S Molloy, Patricia A Bresnahan, Stephen H Leppla, Kurt R Klimpel, and Gary Thomas. Human furin is a calcium-dependent serine endoprotease that recognizes the sequence arg-xx-arg and efficiently cleaves anthrax toxin protective antigen. *Journal of Biological Chemistry*, 267(23):16396–16402, 1992.

92. Wayne J Higgins, Denise M Fox, Piotr S Kowalski, Jens E Nielsen, and D Margaret Worrall. Heparin enhances serpin inhibition of the cysteine protease cathepsin L. *Journal of Biological Chemistry*, 285(6):3722–3729, 2010.

93. Beatrice Kassell and John Kay. Zymogens of proteolytic enzymes. *Science*, 180 (4090):1022–1027, 1973.

94. Klaudia Brix, Christopher J Scott, and Margarete MS Heck. Compartmentalization of proteolysis. In *Proteases: structure and function*, pages 85–125. Springer, 2013.

95. Karen Honey and Alexander Y Rudensky. Lysosomal cysteine proteases regulate antigen presentation. *Nature Reviews Immunology*, 3(6):472, 2003.

96. Gerald Weissmann. The role of lysosomes in inflammation and disease. *Annual Review of Medicine*, 18(1):97–112, 1967.

97. Frederick R Maxfield and Darrell J Yamashiro. Endosome acidification and the pathways of receptor-mediated endocytosis. *Advances in Experimental Medicine and Biology*, 225:189–198, 1987.

98. Willem Stoorvogel, Ger J Strous, Hans J Geuze, Viola Oorschot, and Alan L. Schwartzt. Late endosomes derive from early endosomes by maturation. *Cell*, 65 (3):417–427, 1991.

99. Bruce E Linebaugh, Mansoureh Sameni, Nancy A Day, Bonnie F Sloane, and Daniel Keppler. Exocytosis of active cathepsin B: enzyme activity at pH 7.0, inhibition and molecular mass. *European Journal of Biochemistry*, 264(1):100–109, 1999.

100. Bernd Wiederanders. Structure-function relationships in class CA1 cysteine peptidase propeptides. *Acta Biochimica Polonica*, 50(3):691–713, 2003.

101. Stuart Kornfeld. Structure and function of the mannose 6-phosphate/insulinlike growth factor II receptors. *Annual Review of Biochemistry*, 61(1):307–330, 1992.

102. Dejan Caglič, Jerica Rozman Pungerčar, Gunnar Pejler, Vito Turk, and Boris Turk. Glycosaminoglycans facilitate procathepsin B activation through disruption of propeptide-mature enzyme interactions. *Journal of Biological Chemistry*, 282 (45):33076–33085, 2007.

103. Kanae Shirahama-Noda, Akitsugu Yamamoto, Kazushi Sugihara, Noriyoshi Hashimoto, Masahide Asano, Mikio Nishimura, and Ikuko Hara-Nishimura. Biosynthetic processing of cathepsins and lysosomal degradation are abolished in asparaginyl endopeptidase-deficient mice. *Journal of Biological Chemistry*, 278 (35):33194–33199, 2003.

104. Vito Turk, Veronika Stoka, Olga Vasiljeva, Miha Renko, Tao Sun, Boris Turk, and Dušan Turk. Cysteine cathepsins: from structure, function and regulation to new frontiers. *Biochimica et Biophysica Acta -Proteins and Proteomics*, 1824(1):68–88, 2012.

105. Lixia Zhao, Tian Hua, Christopher Crowley, Heng Ru, Xiangmin Ni, Neil Shaw, Lianying Jiao, Wei Ding, Lu Qu, Li-Wei Hung, Wei Huang, Lei Liu, Ye Keqiang, Songying Ouyang, Genhong Cheng, and Zhi-Jie Liu. Structural analysis of asparaginyl endopeptidase reveals the activation mechanism and a reversible intermediate maturation stage. *Cell Research*, 24(3):344, 2014.

106. Dušan Turk, Gregor Gunčar, Marjetka Podobnik, and Boris Turk. Revised definition of substrate binding sites of papain-like cysteine proteases. *Biological Chemistry*, 379(2):137–147, 1998.

107. Nurith Abramowitz, Israel Schechter, and Arieh Berger. On the size of the active site in proteases II. Carboxypeptidase-A. *Biochemical and Biophysical Research Communications*, 29(6):862–867, 1967.

108. Reik Löser and Jens Pietzsch. Cysteine cathepsins: their role in tumor progression and recent trends in the development of imaging probes. *Frontiers in Chemistry*, 3:37, 2015.

109. Wu-Shiun Hou, Zhenqiang Li, Ronald E Gordon, Kyle Chan, Michael J Klein, Roger Levy, Martin Keysser, Gernot Keyszer, and Dieter Brömme. Cathepsin K is a critical protease in synovial fibroblast-mediated collagen degradation. *The American Journal of Pathology*, 159(6):2167–2177, 2001.

110. Izabela Podgorski. Future of anti-cathepsin K drugs: dual therapy for skeletal disease and atherosclerosis? *Future Science*, 1(1):21–34, 2009.

111. S Anwar Jagessar, Inge R Holtman, Sam Hofman, Elena Morandi, Nicole Heijmans, Jon D Laman, Bruno Gran, Bart W Faber, Sander I van Kasteren, Bart JL Eggen, and Bert A ' t Hart. Lymphocryptovirus infection of nonhuman primate B cells converts destructive into productive processing of the pathogenic CD8 T cell epitope in myelin oligodendrocyte glycoprotein. *The Journal of Immunology*, pages 1074–1088, 2016.

112. Bénédicte Manoury, Daniela Mazzeo, Dongtao Ni Li, Jeremy Billson, Kylie Loak, Philippe Benaroch, and Colin Watts. Asparagine endopeptidase can initiate the removal of the MHC class II invariant chain chaperone. *Immunity*, 18(4):489–498, 2003.

113. Bénédicte Manoury. Proteases: Essential actors in processing antigens and intracellular Toll-like receptors. *Frontiers in Immunology*, 4(9):299, 2013.

114. David Van Duin, Ruslan Medzhitov, and Albert C Shaw. Triggering tlr signaling in vaccination. *Trends in Immunology*, 27(1):49–55, 2006.

115. Bénédicte Manoury, Daniela Mazzeo, Lars Fugger, Nick Viner, Mary Ponsford, Heather Streeter, Graziella Mazza, David C Wraith, and Colin Watts. Destructive processing by asparagine endopeptidase limits presentation of a dominant T cell epitope in MBP. *Nature Immunology*, 3(2):169, 2002.

116. Colin Watts, Stephen P Matthews, Daniela Mazzeo, Bénédicte Manoury, and Cathy X Moss. Asparaginyl endopeptidase: case history of a class II MHC compartment protease. *Immunological Reviews*, 207(1):218–228, 2005.

117. Chi-Bun Chan, Michiyo Abe, Noriyoshi Hashimoto, Chunhai Hao, Ifor R. Williams, Xia Liu, Shinji Nakao, Akitsugu Yamamoto, Chengyun Zheng, Jan-Inge Henter, Marie Meeths, Magnus Nordenskjold, Shi-Yong Li, Ikuko Hara-Nishimura, Masahide Asano, and Keqiang Ye. Mice lacking asparaginyl endopeptidase develop disorders resembling hemophagocytic syndrome. *Proceedings of the National Academy of Sciences*, 106(2):468–473, 2009.

118. Lélia Delamarre, Margit Pack, Henry Chang, Ira Mellman, and E Sergio Trombetta. Differential lysosomal proteolysis in antigen-presenting cells determines antigen fate. *Science*, 307(5715):1630–1634, 2005.

119. Lélia Delamarre, Rachael Couture, Ira Mellman, and E Sergio Trombetta. Enhancing immunogenicity by limiting susceptibility to lysosomal proteolysis. *Journal of Experimental Medicine*, 203(9):2049–2055, 2006.

120. Tracy J Ruckwardt, Allison MW Malloy, Kaitlyn M Morabito, and Barney S Graham. Quantitative and qualitative deficits in neonatal lung-migratory dendritic cells impact the generation of the $CD8^+$ T cell response. *PLoS Pathogens*, 10(2): e1003934, 2014.

121. Nadine van Montfoort, Marcel G Camps, Selina Khan, Dmitri V Filippov, Jimmy J Weterings, Janice M Griffith, Hans J Geuze, Thorbald van Hall, J Sjef Verbeek, Cornelis J Melief, and Ferry Ossendorp. Antigen storage compartments in mature dendritic cells facilitate prolonged cytotoxic T lymphocyte cross-priming capacity. *Proceedings of the National Academy of Sciences*, 106(16):6730–6735, 2009.

122. Anne L Ackerman, Alessandra Giodini, and Peter Cresswell. A role for the endoplasmic reticulum protein retrotranslocation machinery during crosspresentation by dendritic cells. *Immunity*, 25(4):607–617, 2006.

123. Hans-Gustaf Ljunggren, Nico J Stam, Claes Öhlén, Jacques J Neefjes, Petter Höglund, Marie-Thérèse Heemels, Judy Bastin, Ton NM Schumacher, Alain Townsend, Klas Kärre, and Hidde L Ploegh. Empty MHC class I molecules come out in the cold. *Nature*, 346(6283):476–480, 1990.

124. Isamu Z Hartman, AeRyon Kim, Robert J Cotter, Kimberly Walter, Sarat K Dalai, Tatiana Boronina, Wendell Griffith, David E Lanar, Robert Schwenk, Urszula Krzych, Robert N Cole, and Scheherazade Sadegh-Nasseri. A reductionist cell-free major histocompatibility complex class II antigen processing system identifies immunodominant epitopes. *Nature Medicine*, 16(11):1333, 2010.

125. Manfred B Lutz, Patrizia Rovere, Monique J Kleijmeer, Maria Rescigno, Caroline U Assmann, VM Oorschot, Hans J Geuze, Jeannine Trucy, Denis Demandolx, Jean Davoust, and Paola Ricciardi-Castagnoli. Intracellular routes and selective retention of antigens in mildly acidic cathepsin D/lysosome-associated membrane protein-1/MHC class II-positive vesicles in immature dendritic cells. *The Journal of Immunology*, 159(8):3707–3716, 1997.

126. Young-Woock Noh, Yong Taik Lim, and Bong Hyun Chung. Noninvasive imaging of dendritic cell migration into lymph nodes using near-infrared fluorescent semiconductor nanocrystals. *The FASEB Journal*, 22(11):3908–3918, 2008.

127. Dennis Ng, Blandine Maître, Derek Cummings, Albert Lin, Lesley A Ward, Ramtin Rahbar, Karen L Mossman, Pamela S Ohashi, and Jennifer L Gommerman. A lymphotoxin/type I IFN axis programs $CD8^+$ T cells to infiltrate a self-tissue and propagate immunopathology. *The Journal of Immunology*, 195(10):4650–4659, 2015.

128. Petr O Ilyinskii, Grigoriy I Kovalev, Conlin P O'Neil, Christopher J Roy, Alicia M Michaud, Natalia M Drefs, Mikhail A Pechenkin, Fenni Fu, Lloyd PM Johnston, Dmitry A Ovchinnikov, and Takashi Kei Kishimoto. Synthetic vaccine particles for durable cytolytic T lymphocyte responses and anti-tumor immunotherapy. *PLoS One*, 13(6):e0197694, 2018.

129. Christopher C Norbury, Benedict J Chambers, Alan R Prescott, Hans-Gustaf Ljunggren, and Colin Watts. Constitutive macropinocytosis allows tap-dependent major histocompatibility compex class I presentation of exogenous soluble antigen by bone marrow-derived dendritic cells. *European Journal of Immunology*, 27(1): 280–288, 1997.

130. Rut Olivar, Ana Luque, Mar Naranjo-Gómez, Josep Quer, Pablo García de Frutos, Francesc E Borràs, Santiago Rodríguez de Córdoba, Anna M Blom, and Josep M Aran. The $\alpha_7\beta_0$ isoform of the complement regulator C4b-binding protein induces a semimature, anti-inflammatory state in dendritic cells. *The Journal of Immunology*, 190(6):2857–2872, 2013.

131. Darío Lirussi, Thomas Ebensen, Kai Schulze, Stephanie Trittel, Veronica Duran, Ines Liebich, Ulrich Kalinke, and Carlos A Guzmán. Type I IFN and not TNF, is essential for cyclic di-nucleotide-elicited CTL by a cytosolic cross-presentation pathway. *EBioMedicine*, 22:100–111, 2017.

132. Mallika Ghosh, Beata McAuliffe, Jaganathan Subramani, Sreyashi Basu, and Linda H Shapiro. CD13 regulates dendritic cell cross-presentation and T cell responses by inhibiting receptor-mediated antigen uptake. *The Journal of Immunology*, 188:5489–5499, 2012.

133. Pallavi A Kadengodlu, Takehisa Hebishima, Shin-Nosuke Takeshima, Mika Ito, Mingzhe Liu, Hiroshi Abe, Yoko Aida, Toshiro Aigaki, and Yoshihiro Ito. Positively charged cholesterol–recombinant human gelatins foster the cellular uptake of proteins and murine immune reactions. *International Journal of Nanomedicine*, 7:5437, 2012.

134. David L Daugherty and Samuel H Gellman. A fluorescence assay for leucine zipper dimerization: Avoiding unintended consequences of fluorophore attachment. *Journal of the American Chemical Society*, 121(18):4325–4333, 1999.

135. Christina Tekle, Bo van Deurs, Kirsten Sandvig, and Tore-Geir Iversen. Cellular trafficking of quantum dot-ligand bioconjugates and their induction of changes in normal routing of unconjugated ligands. *Nano Letters*, 8(7):1858–1865, 2008.

136. Sterre T Paijens, Ninke Leffers, Toos Daemen, Wijnand Helfrich, H Marike Boezen, Ben J Cohlen, Cornelis JM Melief, Marco de Bruyn, and Hans W Nijman. Antigen-specific active immunotherapy for ovarian cancer. *Cochrane Database of Systematic Reviews*, 9(9), 2018.

137. Jon Amund Kyte, Sissel Trachsel, Bente Risberg, Per thor Straten, Kari Lislerud, and Gustav Gaudernack. Unconventional cytokine profiles and development of T cell memory in long-term survivors after cancer vaccination. *Cancer Immunology, Immunotherapy*, 58(10):1609–1626, 2009.

138. Tomonori Iyoda, Susumu Shimoyama, Kang Liu, Yoshiki Omatsu, Yuji Akiyama, Yasuhiro Maeda, Kazuhiko Takahara, Ralph M Steinman, and Kayo Inaba. The $CD8^+$ dendritic cell subset selectively endocytoses dying cells in culture and in vivo. *Journal of Experimental Medicine*, 195(10):1289–1302, 2002.

139. Ninke Leffers, Toos Daemen, Wijnand Helfrich, H Marike Boezen, Ben J Cohlen, Cornelis JM Melief, and Hans W Nijman. Antigen-specific active immunotherapy for ovarian cancer. *Cochrane Database of Systematic Reviews*, 2014.

140. Zhenhai Shen, Glen Reznikoff, Glenn Dranoff, and Kenneth L Rock. Cloned dendritic cells can present exogenous antigens on both MHC class I and class II molecules. *The Journal of Immunology*, 158(6):2723–2730, 1997.

141. Claudia Winzler, Patrizia Rovere, Maria Rescigno, Francesca Granucci, Giuseppe Penna, Luciano Adorini, Valerie S Zimmermann, Jean Davoust, and Paola Ricciardi-Castagnoli. Maturation stages of mouse dendritic cells in growth factor–dependent long-term cultures. *Journal of Experimental Medicine*, 185(2):317–328, 1997.

142. Silvia A Fuertes Marraco, Frédéric Grosjean, Anaïs Duval, Muriel Rosa, Christine Lavanchy, Devika Ashok, Sergio Haller, Luc Otten, Quynh-Giao Steiner, Patrick Descombes, Christian A Luber, Matthias Mann, Lajos Szeles, Walter Reith, and Hans Acha-Orbea. Novel murine dendritic cell lines: a powerful auxiliary tool for dendritic cell research. *Frontiers in Immunology*, 3:331, 2012.

143. Amanda M Yates, Stephen J Elvin, and Diane E Williamson. The optimisation of a murine TNF-α ELISA and the application of the method to other murine cytokines. *Journal of Immunoassay*, 20(1-2):31–44, 1999.

144. Kohtaro Fujihashi, Jerry R McGhee, Kenneth W Beagley, David T McPherson, Sylvia A McPherson, Chun-Ming Huang, and Hiroshi Kiyono. Cytokine-specific ELISPOT assay single cell analysis of IL-2, IL-4 and IL-6 producing cells. *Journal of Immunological Methods*, 160(2):181–189, 1993.

145. Pratip K Chattopadhyay, Joanne Yu, and Mario Roederer. Live-cell assay to detect antigen-specific $CD4^+$ T-cell responses by CD154 expression. *Nature Protocols*, 1 (1):1–6, 2006.

146. Laurie Lamoreaux, Mario Roederer, and Richard Koup. Intracellular cytokine optimization and standard operating procedure. *Nature Protocols*, 1(3):1507, 2006.

147. Jaana Karttunen, Sarah Sanderson, and Nilabh Shastri. Detection of rare antigen-presenting cells by the LacZ T-cell activation assay suggests an expression cloning strategy for T-cell antigens. *Proceedings of the National Academy of Sciences*, 89 (13):6020–6024, 1992.

148. Sarah Sanderson and Nilabh Shastri. LacZ inducible, antigen/MHC-specific T cell hybrids. *International Immunology*, 6(3):369–376, 1994.

149. Henry R Hulett, William A Bonner, Janet Barrett, and Leonard A Herzenberg. Cell sorting: automated separation of mammalian cells as a function of intracellular fluorescence. *Science*, 166(3906):747–749, 1969.

150. Leonard A Herzenberg, Richard G Sweet, and Leonore A Herzenberg. Fluorescence-activated cell sorting. *Scientific American*, 234(3):108–118, 1976.

151. Sirkka Kontiainen, Elizabeth Simpson, Elaine Bohrer, Peter CL Beverley, Leonore A Herzenberg, William C Fitzpatrick, Peter Vogt, Alfredo Torano, Ian FC McKenzie, and Marc Feldmann. T-cell lines producing antigen-specific suppressor factor. *Nature*, 274(5670):477, 1978.

152. David H Canaday. Production of $CD4^+$ and $CD8^+$ T cell hybridomas. In *Antigen Processing*, pages 297–307. Springer, 2013.

153. Peter Van Endert. *Antigen Processing: Methods and Protocols*. Springer, 2013.

154. Scott N Mueller, William R Heath, Julie D McLain, Francis R Carbone, and Claerwen M Jones. Characterization of two TCR transgenic mouse lines specific for herpes simplex virus. *Immunology and Cell Biology*, 80(2):156–163, 2002.

155. Scott N Mueller, Claerwen M Jones, Chris M Smith, William R Heath, and Francis R Carbone. Rapid cytotoxic T lymphocyte activation occurs in the draining lymph nodes after cutaneous herpes simplex virus infection as a result of early antigen presentation and not the presence of virus. *Journal of Experimental Medicine*, 195(5):651–656, 2002.

156. Jaana Karttunen and Nilabh Shastri. Measurement of ligand-induced activation in single viable T cells using the LacZ reporter gene. *Proceedings of the National Academy of Sciences*, 88(9):3972–3976, 1991.

157. Anthony W Purcell and Jeff J Gorman. Immunoproteomics: mass spectrometry-based methods to study the targets of the immune response. *Molecular & Cellular Proteomics*, 3(3):193–208, 2004.

158. Katharina Bluemlein and Markus Ralser. Monitoring protein expression in whole-cell extracts by targeted label-and standard-free LC-MS/MS. *Nature Protocols*, 6 (6):859, 2011.

159. Anthony W Purcell, Nathan P Croft, and David C Tscharke. Immunology by numbers: quantitation of antigen presentation completes the quantitative milieu of systems immunology! *Current Opinion in Immunology*, 40:88–95, 2016.

160. Olaf Rötzschke, Kirsten Falk, Karl Deres, Hansjörg Schild, Maria Norda, Jörg Metzger, Günther Jung, and Hans-Georg Rammensee. Isolation and analysis of naturally processed viral peptides as recognized by cytotoxic T cells. *Nature*, 348 (6298):252–254, 1990.

161. Walter J Storkus, Herbert J Zeh, Russell D Salter, and Michael T Lotze. Identification of T-cell epitopes: rapid isolation of class I-presented peptides from viable cells by mild acid elution. *Journal of Immunotherapy*, 14:94–94, 1993.

162. Daniel J Kowalewski and Stefan Stevanović. Biochemical large-scale identification of MHC class I ligands. In *Antigen Processing*, pages 145–157. Springer, 2013.

163. Juliane Liepe, Fabio Marino, John Sidney, Anita Jeko, Daniel E Bunting, Alessandro Sette, Peter M Kloetzel, Michael PH Stumpf, Albert JR Heck, and Michele Mishto. A large fraction of HLA class I ligands are proteasome-generated spliced peptides. *Science*, 354(6310):354–358, 2016.

164. Daniel J Kowalewski, Heiko Schuster, Linus Backert, Claudia Berlin, Stefan Kahn, Lothar Kanz, Helmut R Salih, Hans-Georg Rammensee, Stefan Stevanovic, and Juliane Sarah Stickel. HLA ligandome analysis identifies the underlying specificities of spontaneous antileukemia immune responses in chronic lymphocytic leukemia (CLL). *Proceedings of the National Academy of Sciences*, 112(2):E166–E175, 2015.

165. Hans-Georg Rammensee and Harpreet Singh-Jasuja. HLA ligandome tumor antigen discovery for personalized vaccine approach. *Expert Review of Vaccines*, 12 (10):1211–1217, 2013.

166. Eliana Saxon and Carolyn R Bertozzi. Cell surface engineering by a modified staudinger reaction. *Science*, 287(5460):2007–2010, 2000.

167. Ellen M Sletten and Carolyn R Bertozzi. Bioorthogonal chemistry: fishing for selectivity in a sea of functionality. *Angewandte Chemie International Edition*, 48 (38):6974–6998, 2009.

168. Hermann Staudinger and Jules Meyer. Über neue organische phosphorverbindungen iii. phosphinmethylenderivate und phosphinimine. *Helvetica Chimica Acta*, 2 (1):635–646, 1919.

169. Nicholas J Agard, Jennifer A Prescher, and Carolyn R Bertozzi. A strain-promoted [3+ 2] azide-alkyne cycloaddition for covalent modification of biomolecules in living systems. *Journal of the American Chemical Society*, 126(46):15046–15047, 2004.

170. Nicholas J Agard, Jeremy M Baskin, Jennifer A Prescher, Anderson Lo, and Carolyn R Bertozzi. A comparative study of bioorthogonal reactions with azides. *ACS Chemical Biology*, 1(10):644–648, 2006.

171. Pamela V Chang, Jennifer A Prescher, Ellen M Sletten, Jeremy M Baskin, Isaac A Miller, Nicholas J Agard, Anderson Lo, and Carolyn R Bertozzi. Copper-free click chemistry in living animals. *Proceedings of the National Academy of Sciences*, 2010.

172. Jennifer A Prescher, Danielle H Dube, and Carolyn R Bertozzi. Chemical remodelling of cell surfaces in living animals. *Nature*, 430(7002):873, 2004.

173. Remon van Geel, Ger JM Pruijn, Floris L van Delft, and Wilbert C Boelens. Preventing thiol-yne addition improves the specificity of strain-promoted azide-alkyne cycloaddition. *Bioconjugate Chemistry*, 23(3):392–398, 2012.

174. Mauro Lo Conte, Samuele Staderini, Alberto Marra, Macarena Sanchez-Navarro, Benjamin G Davis, and Alessandro Dondoni. Multi-molecule reaction of serum albumin can occur through thiol-yne coupling. *Chemical Communications*, 47(39): 11086–11088, 2011.

175. Thomas Bakkum, Tyrza van Leeuwen, Alexi JC Sarris, Daphne M van Elsland, Dimitrios Poulcharidis, Herman S Overkleeft, and Sander I van Kasteren. Quantification of bioorthogonal stability in immune phagocytes using flow cytometry reveals rapid degradation of strained alkynes. *ACS Chemical Biology*, 13(5):1173–1179, 2018.

176. Kathrin Lang and Jason W Chin. Cellular incorporation of unnatural amino acids and bioorthogonal labeling of proteins. *Chemical Reviews*, 114(9):4764–4806, 2014.

177. Kathrin Lang, Lloyd Davis, Stephen Wallace, Mohan Mahesh, Daniel J Cox, Melissa L Blackman, Joseph M Fox, and Jason W Chin. Genetic encoding of bicyclononynes and trans-cyclooctenes for site-specific protein labeling in vitro and in live mammalian cells via rapid fluorogenic diels–alder reactions. *Journal of the American Chemical Society*, 134(25):10317–10320, 2012.

178. Omar Boutureira and Gonçalo JL Bernardes. Advances in chemical protein modification. *Chemical Reviews*, 115(5):2174–2195, 2015.

179. Li-Huai Qin, Wei Hu, and Ya-Qiu Long. Bioorthogonal chemistry: Optimization and application updates during 2013-2017. *Tetrahedron Letters*, 59(23):2214 – 2228, 2018.

180. Anne B Neef and Carsten Schultz. Selective fluorescence labeling of lipids in living cells. *Angewandte Chemie International Edition*, 48(8):1498–1500, 2009.

181. Ishwar Singh and Frances Heaney. Solid phase strain promoted "click"modification of DNA via [3+ 2]-nitrile oxide-cyclooctyne cycloadditions. *Chemical Communications*, 47(9):2706–2708, 2011.

182. Haoxing Wu, Seth C Alexander, Shuaijiang Jin, and Neal K Devaraj. A bioorthogonal near-infrared fluorogenic probe for mRNA detection. *Journal of the American Chemical Society*, 138(36):11429–11432, 2016.

183. Peter Landgraf, Elmer R Antileo, Erin M Schuman, and Daniela C Dieterich. *BONCAT: metabolic labeling, click chemistry, and affinity purification of newly synthesized proteomes*, pages 199–215. Springer, 2015.

184. Nikolaus Krall, Filipa P Da Cruz, Omar Boutureira, and Gonçalo JL Bernardes. Site-selective protein-modification chemistry for basic biology and drug development. *Nature Chemistry*, 8(2):103, 2016.

185. Daniela C Dieterich, A James Link, Johannes Graumann, David A Tirrell, and Erin M Schuman. Selective identification of newly synthesized proteins in mammalian cells using bioorthogonal noncanonical amino acid tagging (BONCAT). *Proceedings of the National Academy of Sciences*, 103(25):9482–9487, 2006.

186. Kristi L Kiick and David A Tirrell. Protein engineering by in vivo incorporation of non-natural amino acids: Control of incorporation of methionine analogues by methionyl-tRNA synthetase. *Tetrahedron*, 56(48):9487–9493, 2000.

187. Jan CM van Hest, Kristi L Kiick, and David A Tirrell. Efficient incorporation of unsaturated methionine analogues into proteins in vivo. *Journal of the American Chemical Society*, 122(7):1282–1288, 2000.

188. John T Ngo and David A Tirrell. Noncanonical amino acids in the interrogation of cellular protein synthesis. *Accounts of Chemical Research*, 44(9):677–685, 2011.

189. Sander I van Kasteren, Holger B Kramer, Henrik H Jensen, Sandra J Campbell, Joanna Kirkpatrick, Neil J Oldham, Daniel C Anthony, and Benjamin G Davis. Expanding the diversity of chemical protein modification allows post-translational mimicry. *Nature*, 446(7139):1105, 2007.

190. Sander I van Kasteren, Holger B Kramer, David P Gamblin, and Benjamin G Davis. Site-selective glycosylation of proteins: creating synthetic glycoproteins. *Nature Protocols*, 2(12):3185, 2007.

191. Roland Hatzenpichler, Silvan Scheller, Patricia L Tavormina, Brett M Babin, David A Tirrell, and Victoria J Orphan. In situ visualization of newly synthesized proteins in environmental microbes using amino acid tagging and click chemistry. *Environmental Microbiology*, 16(8):2568–2590, 2014.

192. Kimberly E Beatty and David A Tirrell. Two-color labeling of temporally defined protein populations in mammalian cells. *Bioorganic & Medicinal Chemistry Letters*, 18(22):5995–5999, 2008.

193. Sarah Calve, Andrew J Witten, Alexander R Ocken, and Tamara L Kinzer-Ursem. Incorporation of non-canonical amino acids into the developing murine proteome. *Scientific Reports*, 6:32377, 2016.

194. Michael Ibba and Dieter Söll. Aminoacyl-tRNA synthesis. *Annual Review of Biochemistry*, 69(1):617–650, 2000.

195. Kai P Yuet, Meenakshi K Doma, John T Ngo, Michael J Sweredoski, Robert LJ Graham, Annie Moradian, Sonja Hess, Erin M Schuman, Paul W Sternberg, and David A Tirrell. Cell-specific proteomic analysis in caenorhabditis elegans. *Proceedings of the National Academy of Sciences*, 112(9):2705–2710, 2015.

196. Arun K Upadhyay, Aruna Murmu, Anupam Singh, and Amulya K Panda. Kinetics of inclusion body formation and its correlation with the characteristics of protein aggregates in Escherichia coli. *PLoS One*, 7(3):e33951, 2012.

197. Daniel B McClatchy, Yuanhui Ma, Chao Liu, Benjamin D Stein, Salvador Martínez-Bartolomé, Debbie Vasquez, Kristina Hellberg, Reuben J Shaw, and John R Yates III. Pulsed azidohomoalanine labeling in mammals (PALM) detects changes in liver-specific LKB1 knockout mice. *Journal of Proteome Research*, 14(11):4815–4822, 2015.

198. Lei Wang, Ansgar Brock, Brad Herberich, and Peter G Schultz. Expanding the genetic code of Escherichia coli. *Science*, 292(5516):498–500, 2001.

199. Alexander Deiters and Peter G Schultz. In vivo incorporation of an alkyne into proteins in Escherichia coli. *Bioorganic & Medicinal Chemistry Letters*, 15(5):1521–1524, 2005.

200. Tomasz Fekner, Xin Li, Marianne M Lee, and Michael K Chan. A pyrrolysine analogue for protein click chemistry. *Angewandte Chemie International Edition*, 48(9):1633–1635, 2009.

201. Weiwei A Li, Zachary T Barry, Joshua D Cohen, Catera L Wilder, Rebecca J Deeds, Philip M Keegan, and Manu O Platt. Detection of femtomole quantities of mature cathepsin K with zymography. *Analytical Biochemistry*, 401(1):91–98, 2010.

202. Xin Li, Tomasz Fekner, and Michael K Chan. N6-(2-(r)-propargylglycyl) lysine as a clickable pyrrolysine mimic. *Chemistry-An Asian Journal*, 5(8):1765–1769, 2010.

203. Wei Wan, Jeffery M Tharp, and Wenshe R Liu. Pyrrolysyl-tRNA synthetase: an ordinary enzyme but an outstanding genetic code expansion tool. *Biochimica et Biophysica Acta -Proteins and Proteomics*, 1844(6):1059–1070, 2014.

204. Sandra Lepthien, Lars Merkel, and Nediljko Budisa. In vivo double and triple labeling of proteins using synthetic amino acids. *Angewandte Chemie International Edition*, 49(32):5446–5450, 2010.

205. Lars Merkel, Melina Schauer, Garabed Antranikian, and Nediljko Budisa. Parallel incorporation of different fluorinated amino acids: on the way to "teflon"proteins. *ChemBioChem*, 11(11):1505–1507, 2010.

206. Jeff E Grotzke, Qiao Lu, and Peter Cresswell. Deglycosylation-dependent fluorescent proteins provide unique tools for the study of ER-associated degradation. *Proceedings of the National Academy of Sciences*, 110(9):3393–3398, 2013.

207. Daphne Marjoleine van Elsland. *A bioorthogonal chemistry approach to the study of biomolecules in their ultrastructural cellular context.* PhD thesis, Leiden University, 2018.

208. Daphne M. van Elsland, Erik Bos, Herman S. Overkleeft, Abraham J. Koster, and Sander I. van Kasteren. The potential of bioorthogonal chemistry for correlative light and electron microscopy: a call to arms. *Journal of Chemical Biology*, 8(4): 153–157, 2015.

209. Lee Kim Swee, Carla P Guimaraes, Sharvan Sehrawat, Eric Spooner, M Inmaculada Barrasa, and Hidde L Ploegh. Sortase-mediated modification of αDEC205 affords optimization of antigen presentation and immunization against a set of

viral epitopes. *Proceedings of the National Academy of Sciences*, 110(4):1428–1433, 2013.

210. William B Wood. Host specificity of DNA produced by Escherichia coli: bacterial mutations affecting the restriction and modification of DNA. *Journal of Molecular Biology*, 16(1):118–IN3, 1966.

211. Natasha Del Cid, Lianjun Shen, Janice BelleIsle, and Malini Raghavan. Assessment of roles for calreticulin in the cross-presentation of soluble and bead-associated antigens. *PLoS One*, 7(7):e41727, 2012.

212. Christopher D Spicer, Therese Triemer, and Benjamin G Davis. Palladium-mediated cell-surface labeling. *Journal of the American Chemical Society*, 134 (2):800–803, 2011.

213. Larry McReynolds, Bert W O'Malley, Andrew D Nisbet, John E Fothergill, David Givol, Stanley Fields, Mark A Robertson, and George G Brownlee. Sequence of chicken ovalbumin mRNA. *Nature*, 273(5665):723–728, 1978.

214. M Can Araman, Linda Pieper Pournara, Arieke SB Kampstra, Mikkel HS Marqvorsen, Clarissa Nascimento, Willemijn van der Wulp, Mirjam GJM Groenewold, Marcel GM Camps, Ferry Ossendorp, Rene Toes, and Sander I van Kasteren. Bioorthogonal antigens allow the study of intracellular processing and presentation of post-translationally modified antigens. *bioRxiv*, page 439323, 2018.

215. Norma J Greenfield. Using circular dichroism collected as a function of temperature to determine the thermodynamics of protein unfolding and binding interactions. *Nature Protocols*, 1(6):2527, 2006.

216. Boris A Mamyrin. Time-of-flight mass spectrometry (concepts, achievements, and prospects). *International Journal of Mass Spectrometry*, 206(3):251–266, 2001.

217. Sven Burgdorf, Andreas Kautz, Volker Böhnert, Percy A Knolle, and Christian Kurts. Distinct pathways of antigen uptake and intracellular routing in CD4 and CD8 T cell activation. *Science*, 316(5824):612–616, 2007.

218. Sven Burgdorf, Verena Schuette, Verena Semmling, Katharina Hochheiser, Veronika Lukacs-Kornek, Percy A Knolle, and Christian Kurts. Steady-state cross-presentation of OVA is mannose receptor-dependent but inhibitable by collagen fragments. *Proceedings of the National Academy of Sciences*, 107(13):E48–E49, 2010.

219. Daniel Kolarich, Bernd Lepenies, and Peter H Seeberger. Glycomics, glycoproteomics and the immune system. *Current Opinion in Chemical Biology*, 16(1-2): 214–220, 2012.

220. Morten Meldal and Christian Wenzel Tornøe. Cu-catalyzed azide- alkyne cycloaddition. *Chemical Reviews*, 108(8):2952–3015, 2008.

221. Michele A West, Robert PA Wallin, Stephen P Matthews, Henrik G Svensson, Rossana Zaru, Hans-Gustaf Ljunggren, Alan R Prescott, and Colin Watts. Enhanced dendritic cell antigen capture via Toll-like receptor-induced actin remodeling. *Science*, 305(5687):1153–1157, 2004.

222. Peter Duewell, Ulrich Kisser, Klaus Heckelsmiller, Sabine Hoves, Patrizia Stoitzner, Sandra Koernig, Adriana B Morelli, Björn E Clausen, Marc Dauer, Andreas Eigler, David Anz, Carole Bourquin, Eugene Maraskovsky, Stefan Endres, and Max Schurr. ISCOMATRIX adjuvant combines immune activation with antigen delivery to dendritic cells in vivo leading to effective cross-priming of $CD8^+$ T cells. *The Journal of Immunology*, pages 55–63, 2011.

223. Tyrza van Leeuwen, M Can Araman, Linda Pieper Pournara, Arieke SB Kampstra, Thomas Bakkum, Mikkel Haarslev Schröder Marqvorsen, Clarissa R Nascimento, Mirjam Groenewold, Willemijn van der Wulp, Marcel GM Camps, George MC Janssen, Peter A van Veelen, Gerard Van Westen, Antonius Janssen, Bobby I Florea, Hermen Overkleeft, Ferry Ossendorp, Rene EM Toes, and Sander I van Kasteren. Bioorthogonal protein labelling enables the study of antigen processing of citrullinated and carbamylated auto-antigens. *RSC Chemical Biology*, pages 855–862, 2021.

224. Steven Gillis, Mary M Ferm, Winny Ou, and Kendall A Smith. T cell growth factor: parameters of production and a quantitative microassay for activity. *The Journal of Immunology*, 120(6):2027–2032, 1978.

225. Bruce L Levine, Yuji Ueda, Nancy Craighead, Mark L Huang, and Carl H June. CD28 ligands CD80 (B7-1) and CD86 (B7-2) induce long-term autocrine growth of $CD4^+$ T cells and induce similar patterns of cytokine secretion in vitro. *International Immunology*, 7(6):891–904, 1995.

226. Alba Silipo, Cristina De Castro, Rosa Lanzetta, Michelangelo Parrilli, and Antonio Molinaro. Lipopolysaccharides. In *Prokaryotic Cell Wall Compounds*, pages 133–153. Springer, 2010.

227. Victoria EB Hipolito, Jacqueline A Diaz, Kristofferson V Tandoc, Christian Oertlin, Johannes Ristau, Neha Chauhan, Amra Saric, Shannon Mclaughlan, Ola Larsson, Ivan Topisirovic, and Roberto J Botelho. Enhanced translation expands the endo-lysosome size and promotes antigen presentation during phagocyte activation. *PLoS Biology*, 17(12):e3000535, 1–43, 2019.

228. Harald Nothaft and Christine M Szymanski. Protein glycosylation in bacteria: sweeter than ever. *Nature Reviews Microbiology*, 8(11):765, 2010.

229. Megan J Barnden, Jan Allison, William R Heath, and Francis R Carbone. Defective TCR expression in transgenic mice constructed using cDNA-based α-and β-chain genes under the control of heterologous regulatory elements. *Immunology and Cell Biology*, 76(1):34–40, 1998.

230. Lucy Stols, Minyi Gu, Lynda Dieckman, Rosemarie Raffen, Frank R Collart, and Mark I Donnelly. A new vector for high-throughput, ligation-independent cloning encoding a tobacco etch virus protease cleavage site. *Protein Expression and Purification*, 25(1):8–15, 2002.

231. Mingzi M Zhang, Lun K Tsou, Guillaume Charron, Anuradha S Raghavan, and Howard C Hang. Tandem fluorescence imaging of dynamic s-acylation and protein turnover. *Proceedings of the National Academy of Sciences*, 107(19):8627–8632, 2010.

232. Carolin C Lechner, Ninad D Agashe, and Beat Fierz. Traceless synthesis of asymmetrically modified bivalent nucleosomes. *Angewandte Chemie International Edition*, 55(8):2903–2906, 2016.

233. Claudia Arndt, Stefanie Koristka, Holger Bartsch, and Michael Bachmann. Native polyacrylamide gels. In *Protein Electrophoresis*, pages 49–53. Springer, 2012.

234. Nan Li, Reyna KV Lim, Selvakumar Edwardraja, and Qing Lin. Copper-free sonogashira cross-coupling for functionalization of alkyne-encoded proteins in aqueous medium and in bacterial cells. *Journal of the American Chemical Society*, 133(39):15316–15319, 2011.

235. Heather A Michaels and Lei Zhu. Tris (3-hydroxypropyltriazolylmethyl) amine (TTMA). *e-EROS Encyclopedia of Reagents for Organic Synthesis*, pages 1–4, 2011.

236. Heather A Michaels and Lei Zhu. Tris (3-hydroxypropyltriazolylmethyl) amine (THPTA). *e-EROS Encyclopedia of Reagents for Organic Synthesis*, pages 1–4, 2011.

237. Selina Khan, Martijn S Bijker, Jimmy J Weterings, Hans J Tanke, Gosse J Adema, Thorbald van Hall, Jan W Drijfhout, Cornelis JM Melief, Hermen S Overkleeft, Gijsbert A van der Marel, Dmitri V Filippov, Sjoerd H van der Burg, and Ferry Ossendorp. Distinct uptake mechanisms but similar intracellular processing of two different Toll-like receptor ligand-peptide conjugates in dendritic cells. *Journal of Biological Chemistry*, 282(29):21145–21159, 2007.

238. Kayo Inaba, Muneo Inaba, Nikolaus Romani, Hideki Aya, Masashi Deguchi, Susumu Ikehara, Shigeru Muramatsu, and Ralph M Steinman. Generation of large numbers of dendritic cells from mouse bone marrow cultures supplemented with granulocyte/macrophage colony-stimulating factor. *Journal of Experimental Medicine*, 176(6):1693–1702, 1992.

239. Sascha Hoogendoorn, Gijs HM van Puijvelde, Johan Kuiper, Gijs A van der Marel, and Herman S Overkleeft. A multivalent ligand for the mannose-6-phosphate receptor for endolysosomal targeting of an activity-based probe. *Angewandte Chemie International Edition*, 53(41):10975–10978, 2014.

240. Alessandra Mortellaro, Matteo Urbano, Stefania Citterio, Maria Foti, Francesca Granucci, and Paola Ricciardi-Castagnoli. Generation of murine growth factor-dependent long-term dendritic cell lines to investigate host-parasite interactions. In *Macrophages and Dendritic Cells*, pages 17–27. Springer, 2009.

241. WC Raschke, S Baird, P Ralph, and I Nakoinz. Functional macrophage cell lines transformed by abelson leukemia virus. *Cell*, 15(1):261–267, 1978.

242. Shigeru Tsuchiya, Michiko Yamabe, Yoshiko Yamaguchi, Yasuko Kobayashi, Tasuke Konno, and Keiya Tada. Establishment and characterization of a human acute monocytic leukemia cell line (THP-1). *International Journal of Cancer*, 26(2): 171–176, 1980.

243. Gal Cafri, Adi Sharbi-Yunger, Esther Tzehoval, and Lea Eisenbach. Production of LacZ inducible T cell hybridoma specific for human and mouse gp10025-33 peptides. *PLoS One*, 8(2):e55583, 2013.

244. Kristin A Hogquist, Stephen C Jameson, William R Heath, Jane L Howard, Michael J Bevan, and Francis R Carbone. T cell receptor antagonist peptides induce positive selection. *Cell*, 76(1):17–27, 1994.

245. Sally RMcK Clarke, Megan Barnden, Christian Kurts, Francis R Carbone, Jacques Fap Miller, and William R Heath. Characterization of the ovalbumin-specific TCR transgenic line OT-I: MHC elements for positive and negative selection. *Immunology and Cell Biology*, 78(2):110, 2000.

246. Jennifer M Robertson, Peter E Jensen, and Brian D Evavold. DO11. 10 and OT-II T cells recognize a C-terminal ovalbumin 323–339 epitope. *The Journal of Immunology*, 164(9):4706–4712, 2000.

247. Kenneth M Murphy, Amy B Heimberger, and Dennis Y Loh. Induction by antigen of intrathymic apoptosis of $CD4^{+}$ $CD8^{+}$ TCRlo thymocytes in vivo. *Science*, 250 (4988):1720–1723, 1990.

248. Detlef Dieckmann, Heidi Plottner, Susanne Berchtold, Thomas Berger, and Gerold Schuler. Ex vivo isolation and characterization of $CD4^{+}$ $CD25^{+}$ T cells with regulatory properties from human blood. *Journal of Experimental Medicine*, 193 (11):1303–1310, 2001.

249. Emily Louis, Ulrika Raue, Yifan Yang, Bozena Jemiolo, and Scott Trappe. Time course of proteolytic, cytokine, and myostatin gene expression after acute exercise in human skeletal muscle. *Journal of Applied Physiology*, 103(5):1744–1751, 2007.

250. Stephen P Matthews, Ingrid Werber, Jan Deussing, Christoph Peters, Thomas Reinheckel, and Colin Watts. Distinct protease requirements for antigen presentation in vitro and in vivo. *The Journal of Immunology*, 184(5):2423–2431, 2010.

251. Umar Mahmood and Ralph Weissleder. Near-infrared optical imaging of proteases in cancer. *Molecular Cancer Therapeutics*, 2(5):489–496, 2003.

252. Martijn Verdoes, Laura E Edgington, Ferenc A Scheeren, Melissa Leyva, Galia Blum, Kipp Weiskopf, Michael H Bachmann, Jonathan A Ellman, and Matthew Bogyo. A nonpeptidic cathepsin S activity-based probe for noninvasive optical imaging of tumor-associated macrophages. *Chemistry & Biology*, 19(5):619–628, 2012.

253. Richard DA Wilkinson, Rich Williams, Christopher J Scott, and Roberta E Burden. Cathepsin S: therapeutic, diagnostic, and prognostic potential. *Biological Chemistry*, 396(8):867–882, 2015.

254. Neil D Rawlings, Matthew Waller, Alan J Barrett, and Alex Bateman. MEROPS : the database of proteolytic enzymes, their substrates and inhibitors. *Nucleic Acids Research*, 42(D1):D503–D509, 2014.

255. Neil D Rawlings, Alan J Barrett, Paul D Thomas, Xiaosong Huang, Alex Bateman, and Robert D Finn. The MEROPS database of proteolytic enzymes, their substrates and inhibitors in 2017 and a comparison with peptidases in the PANTHER database. *Nucleic Acids Research*, 46(D1):D624–D632, 2018.

256. John S. Mort and David J. Buttle. Cathepsin B. *The International Journal of Biochemistry & Cell Biology*, 29(5):715–720, 1997.

257. Heidrun Kirschke, HJ Kärgel, Susanne Riemann, and Peter Bohley. Cathepsin L. In *Proteinases and their Inhibitors*, pages 93–101. Pergamon, 1981.

258. Heidrun Kirschke. Cathepsin S. In Neil D Rawlings and Guy Salvesen, editors, *Handbook of Proteolytic Enzymes (Third Edition)*, pages 1824–1830. Academic Press, 2013.

259. Esther BE Plüger, Marianne Boes, Christopher Alfonso, Christian J Schröter, Hubert Kalbacher, Hidde L Ploegh, and Christoph Driessen. Specific role for cathepsin S in the generation of antigenic peptides in vivo. *European Journal of Immunology*, 32(2):467–476, 2002.

260. Christoph Driessen, Ana-Maria Lennon-Duménil, and Hidde L Ploegh. Individual cathepsins degrade immune complexes internalized by antigen-presenting cells via Fcγ receptors. *European Journal of Immunology*, 31(5):1592–1601, 2001.

261. Chyi-Song Hsieh, Karen Honey, Courtney Beers, and Alexander Y Rudensky. A role for cathepsin L and cathepsin S in peptide generation for MHC class II presentation. *The Journal of Immunology*, 168(6):2618–2625, 2002.

262. Colin Watts, Cathy X Moss, Daniela Mazzeo, Michele A West, Stephen P Matthews, Dongtao Ni Li, and Bénédicte Manoury. Creation versus destruction of T cell epitopes in the class II MHC pathway. *Annals of the New York Academy of Sciences*, 987(1):9–14, 2003.

263. Volker Claus, Andrea Jahraus, Torunn Tjelle, Trond Berg, Heidrun Kirschke, Heinz Faulstich, and Gareth Griffiths. Lysosomal enzyme trafficking between phagosomes, endosomes, and lysosomes in J774 macrophages: enrichment of cathepsin H in early endosomes. *Journal of Biological Chemistry*, 273(16):9842–9851, 1998.

264. Heidrun Kirschke, Alan J Barrett, and Neil D Rawlings. *Lysosomal cysteine proteases*. Oxford University Press, 1998.

265. Leendert A Trouw, Theo Rispens, and Rene EM Toes. Beyond citrullination: other post-translational protein modifications in rheumatoid arthritis. *Nature Reviews Rheumatology*, 13(6):331, 2017.

266. Arieke SB Kampstra and René EM Toes. HLA class II and rheumatoid arthritis: the bumpy road of revelation. *Immunogenetics*, 69(8-9):597–603, 2017.

267. Jurgen van Heemst, Diahann TSL Jansen, Savvas Polydorides, Antonis K Moustakas, Marieke Bax, Anouk L Feitsma, Diënne G Bontrop-Elferink, Martine Baarse, Diane Van Der Woude, Gert-Jan Wolbink, et al. Crossreactivity to vinculin and microbes provides a molecular basis for HLA-based protection against rheumatoid arthritis. *Nature Communications*, 6:6681, 2015.

268. Philip J Titcombe, Gustaf Wigerblade, Natalie Sippl, Na Zhang, Anna K Shmagel, Peter Sahlström, Yue Zhang, Laura O Barsness, Yogita Ghodke-Puranik, Azar Baharpoor, et al. Pathogenic citrulline-multispecific B cell receptor clades in rheumatoid arthritis. *Arthritis & Rheumatology*, 2018.

269. Rudolf Schoenheimer, S Ratner, and D Rittenberg. Studies in protein metabolism VII. The metabolism of tyrosine. *Journal of Biological Chemistry*, 127(1):333–344, 1939.

270. Gerard A Schellekens, Ben AW de Jong, Frank HJ van den Hoogen, LB Van de Putte, and Walther J van Venrooij. Citrulline is an essential constituent of antigenic determinants recognized by rheumatoid arthritis-specific autoantibodies. *The Journal of Clinical Investigation*, 101(1):273–281, 1998.

271. Adriaan D Bins, Monika C Wolkers, Marly D van den Boom, John BAG Haanen, and Ton NM Schumacher. In vivo antigen stability affects DNA vaccine immunogenicity. *The Journal of Immunology*, 179(4):2126–2133, 2007.

272. Juan Fando and Santiago Grisolia. Carbamylation of brain proteins with cyanate in vitro and in vivo. *European Journal of Biochemistry*, 47(2):389–396, 1974.

273. Chunghee Cho, Donna O'Dell Bunch, Jean-Emmanuel Faure, Eugenia H Goulding, Edward M Eddy, Paul Primakoff, and Diana G Myles. Fertilization defects in sperm from mice lacking fertilin *β*. *Science*, 281(5384):1857–1859, 1998.

274. Imawati Budihardjo, Holt Oliver, Michael Lutter, Xu Luo, and Xiaodong Wang. Biochemical pathways of caspase activation during apoptosis. *Annual Review of Cell and Developmental Biology*, 15(1):269–290, 1999.

275. Jennifer E Koblinski, Mamoun Ahram, and Bonnie F Sloane. Unraveling the role of proteases in cancer. *Clinica Chimica Acta*, 291(2):113–135, 2000.

276. Boris Turk. Targeting proteases: successes, failures and future prospects. *Nature Reviews Drug Discovery*, 5(9):785–799, 2006.

277. Olivia Steele-Mortimer. The salmonella-containing vacuole - moving with the times. *Current Opinion in Microbiology*, 11(1):38–45, 2008.

278. Melvin G Rosenfeld, Gert Kreibich, Doina Popov, Keitaro Kato, and David D Sabatini. Biosynthesis of lysosomal hydrolases: their synthesis in bound polysomes and the role of co-and post-translational processing in determining their subcellular distribution. *The Journal of Cell Biology*, 93(1):135–143, 1982.

279. Sander I van Kasteren, Hermen Overkleeft, Huib Ovaa, and Jacques Neefjes. Chemical biology of antigen presentation by MHC molecules. *Current Opinion in Immunology*, 26:21–31, 2014.

280. José A Villadangos, Rebecca AR Bryant, Jan Deussing, Christoph Driessen, Ana-Maria Lennon-Duménil, Richard J Riese, Wera Roth, Paul Saftig, Guo-Ping Shi, Harold A Chapman, Christoph Peters, and Hidde L Ploegh. Proteases involved in MHC class II antigen presentation. *Immunological Reviews*, 172(1):109–120, 1999.

281. Kenneth L Rock, Diego J Farfán-Arribas, and Lianjun Shen. Proteases in MHC class I presentation and cross-presentation. *The Journal of Immunology*, 184(1): 9–15, 2010.

282. Kenneth L Rock, Eric Reits, and Jacques Neefjes. Present yourself! by MHC class I and MHC class II molecules. *Trends in Immunology*, 37(11):724–737, 2016.

283. Emil R Unanue, Vito Turk, and Jacques Neefjes. Variations in MHC class II antigen processing and presentation in health and disease. *Annual Review of Immunology*, 34:265–297, 2016.

284. Michael D Rosenblum, Kelly A Remedios, and Abul K Abbas. Mechanisms of human autoimmunity. *The Journal of Clinical Investigation*, 125(6):2228–2233, 2015.

285. Jason Yi, Lakshmi Balagopalan, Tiffany Nguyen, Katherine M McIntire, and Lawrence E Samelson. TCR microclusters form spatially segregated domains and sequentially assemble in calcium-dependent kinetic steps. *Nature Communications*, 10(1):1–13, 2019.

286. Pierre Guermonprez, Jenny Valladeau, Laurence Zitvogel, Clotilde Théry, and Sebastian Amigorena. Antigen presentation and T cell stimulation by dendritic cells. *Annual Review of Immunology*, 20(1):621–667, 2002.

287. Youngchool Choe, Francesco Leonetti, Doron C Greenbaum, Fabien Lecaille, Matthew Bogyo, Dieter Brömme, Jonathan A Ellman, and Charles S Craik. Substrate profiling of cysteine proteases using a combinatorial peptide library identifies functionally unique specificities. *Journal of Biological Chemistry*, 281(18): 12824–12832, 2006.

288. Špela Magister and Janko Kos. Cystatins in Immune system. *Journal of Cancer*, 4(1):45, 2013.

289. Ariel Savina, Carolina Jancic, Stephanie Hugues, Pierre Guermonprez, Pablo Vargas, Ivan Cruz Moura, Ana-Maria Lennon-Duménil, Miguel C Seabra, Graça Raposo, and Sebastian Amigorena. Nox2 controls phagosomal pH to regulate antigen processing during crosspresentation by dendritic cells. *Cell*, 126(1):205–218, 2006.

290. Sandra Scheiblhofer, Josef Laimer, Yoan Machado, Richard Weiss, and Josef Thalhamer. Influence of protein fold stability on immunogenicity and its implications for vaccine design. *Expert Review of Vaccines*, 16(5):479–489, 2017.

291. Takanori So, Hiro-O Ito, Toshitaka Koga, Sanae Watanabe, Tadashi Ueda, and Taiji Imoto. Depression of T-cell epitope generation by stabilizing hen lysozyme. *Journal of Biological Chemistry*, 272(51):32136–32140, 1997.

292. Takatoshi Ohkuri, Satoko Nagatomo, Kenji Oda, Takanori So, Taiji Imoto, and Tadashi Ueda. A protein's conformational stability is an immunologically dominant factor: evidence that free-energy barriers for protein unfolding limit the immunogenicity of foreign proteins. *The Journal of Immunology*, 185(7):4199–4205, 2010.

293. Ricardo Carrion Jr and Jean L Patterson. An animal model that reflects human disease: the common marmoset (Callithrix jacchus). *Current Opinion in Virology*, 2(3):357–362, 2012.

294. Ignacio Cebrian, Geraldine Visentin, Nicolas Blanchard, Mabel Jouve, Alexandre Bobard, Catarina Moita, Jost Enninga, Luis F Moita, Sebastian Amigorena, and Ariel Savina. Sec22b regulates phagosomal maturation and antigen crosspresentation by dendritic cells. *Cell*, 147(6):1355–1368, 2011.

295. Alessandra Giodini and Peter Cresswell. Hsp90-mediated cytosolic refolding of exogenous proteins internalized by dendritic cells. *The EMBO Journal*, 27(1):201–211, 2008.

296. Edward W Voss Jr, Creg J Workman, and Mark E Mummert. Detection of protease activity using a fluorescence-enhancement globular substrate. *Biotechniques*, 20 (2):286–291, 1996.

297. Andrew M Pickering and Kelvin JA Davies. A simple fluorescence labeling method for studies of protein oxidation, protein modification, and proteolysis. *Free Radical Biology and Medicine*, 52(2):239–246, 2012.

298. Michael F Princiotta, Diana Finzi, Shu-Bing Qian, James Gibbs, Sebastian Schuchmann, Frank Buttgereit, Jack R Bennink, and Jonathan W Yewdell. Quantitating protein synthesis, degradation, and endogenous antigen processing. *Immunity*, 18(3):343–354, 2003.

299. Nousheen Zaidi, Timo Herrmann, Daniel Baechle, Sabine Schleicher, Jeannette Gogel, Christoph Driessen, Wolfgang Voelter, and Hubert Kalbacher. A new approach for distinguishing cathepsin E and D activity in antigen-processing organelles. *The FEBS Journal*, 274(12):3138–3149, 2007.

300. Carlo P Ramil and Qing Lin. Bioorthogonal chemistry: strategies and recent developments. *Chemical Communications*, 49(94):11007–11022, 2013.

301. Kirsti L Kiick, Ralf Weberskirch, and David A Tirrell. Identification of an expanded set of translationally active methionine analogues in Escherichia coli. *Febs Letters*, 502(1-2):25–30, 2001.

302. Ernest L Eliel and Samuel H Wilen. *Topics in stereochemistry*, volume 21. John Wiley & Sons, 2009.

303. Kathrin Lang and Jason W. Chin. Bioorthogonal reactions for labeling proteins. *ACS Chemical Biology*, 9(1):16–20, 2014.

304. Tilman M Hackeng, John H Griffin, and Philip E Dawson. Protein synthesis by native chemical ligation: expanded scope by using straightforward methodology. *Proceedings of the National Academy of Sciences*, 96(18):10068–10073, 1999.

305. Vangelis Agouridas, Ouafâa El Mahdi, Vincent Diemer, Marine Cargoët, Jean-Christophe M Monbaliu, and Oleg Melnyk. Native chemical ligation and extended methods: mechanisms, catalysis, scope, and limitations. *Chemical Reviews*, 119 (12):7328–7443, 2019.

306. Cornelis J.M. Melief and Sjoerd H. van der Burg. Immunotherapy of established (pre)malignant disease by synthetic long peptide vaccines. *Nature Reviews Cancer*, 8(5):351–360, 2008.

307. Esther D Quakkelaar and Cornelis JM Melief. Experience with synthetic vaccines for cancer and persistent virus infections in nonhuman primates and patients. In *Advances in Immunology*, volume 114, pages 77–106. Elsevier, 2012.

308. Muriel Amblard, Jean-Alain Fehrentz, Jean Martinez, and Gilles Subra. Methods and protocols of modern solid phase peptide synthesis. *Molecular Biotechnology*, 33(3):239–254, 2006.

309. Albert Isidro-Llobet, Mercedes Alvarez, and Fernando Albericio. Amino acid-protecting groups. *Chemical Reviews*, 109(6):2455–2504, 2009.

310. Markus Gude, Jeannine Ryf, and Peter D White. An accurate method for the quantitation of Fmoc-derivatized solid phase supports. *Letters in Peptide Science*, 9(4):203–206, 2002.

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List of Abbreviations

$\Delta\varepsilon$	difference between the absorption of left-handed (ε_R) and right-handed (ε_L) circularly polarized light in CD . . . 34
∂	molar ellipticity, deg cm^2 $dmol^{-1}$ = $\Delta\varepsilon$ . . . 26
aaRS	aminoacyl transfer RNA synthase . . . 15
AB	antibiotic . . . 17
ACN	acetonitrile, CAS 75-05-8 . . . 76
ACPA	anti-citrullinated protein antibodies, are auto-antibodies that are directed against peptides and proteins that are citrullinated . . . 44
AEP	asparagine endopeptidase or legumain, endosomal and lysosomal cysteine protease . . . 43
AEP	asparagine endopeptidase or legumain . . . 6
$AEP^{-/-}$ APCs	antigen presenting cells derived from mice deficient for both asparagine endopeptidase alleles . . . 43
Ag	antigen . . . 17
Aha	azidohomoalanine, non-canonical amino acid . . . 15
Ala	alanine, amino acid, A . . . 4
amp	ampicillin, antibiotic used to prevent undesired bacterial growth . . 33
APC	antigen presenting cell . . . 3
apo-HRP	apo-horseradish peroxidase, stabilized form of horseradish peroxidase 60
Asn	asparagine, amino acid, N . . . 7
ATG	start codon, AUG in the corresponding messenger RNA sequence, coding for methionine . . . 33
B cell	B lymphocyte, type of white blood cell, that plays a central role in cell-mediated immunity, produce antibodies and mature in the bone marrow and dendritic cells of the immune system . . . 3

B3Z T cell	T cell hybridoma derived from a CD8 T cell specific for a cross-presented ovalbumin epitope (256-264, SIINFEKL) presented on MHC-I 10
beta-gal	beta-galactosidase, an intracellular enzyme that cleaves the disaccharide lactose into glucose and galactose encoded by the LacZ gene 10
beta-ME	beta-mercaptoethanol, used for example to reduce disulfide bonds, CAS 60-24-2 32
BMDC	bone marrow-derived dendritic cell, potent antigen presenting cells raised from murine or human bone marrow 10
C. histolyticum	*Clostridium histolyticum*, gram-positive bacterium causing e.g., gas gangrene found in soil and feces 31
C. jacchus	*Callithrix jacchus*, the common marmoset is one kind of the so-called New World monkeys, which is used as an animal model for human diseases 60
C. pneumoniae	*Chlamydia pneumoniae*, intracellular bacterium causing inflammatory condition of the lung in humans 3
$CaCl_2$	calcium chloride, CAS 10043-52-4 56
CatB	cathepsin B, lysosomal cysteine protease 43
CatD	cathepsin D, lysosomal aspartyl protease 43
CatH	lysosomal cysteine peptidases exhibiting predominant amino-peptidase and limited endopeptidase activity 43
CatL	cathepsin L, lysosomal cysteine protease 43
CatS	cathepsin S, lysosomal cysteine protease 43
CBB	Coomassie Brilliant Blue, CAS 6104-59-2 32
ccHc	copper-catalysed Huisgen cycloaddition, a 1,3-dipolar cycloaddition between an azide and a terminal or internal alkyne resulting in a 1,2,3-triazole using copper(I) as catalyst and a reducing agent 22
CD	circular dichroism spectroscopy, rapid method for determination of the secondary structure and folding properties of proteins that have been obtained using recombinant techniques or were purified from tissues 21
CD11c	transmembrane protein found at high levels on most human dendritic cells, but also on monocytes, macrophages, neutrophils, and some B lymphocytes 38
CD4	cluster of differentiation 4, glycoprotein serving as co-receptor for the T cell receptor, which bind together to peptide MHC class-I molecule complexes 4

CD4 T cell	$CD4^+$ T cell, T_{helper} cell expressing the CD4 surface protein	4
CD45.1	cluster of differentiation 45.1, congenic marker, also known as Ly5.1, routinely used in scientific research to allow identification of cells e.g., to distinguish donor and host cells	38
CD74	cluster of differentiation 74, is a protein that in humans encodes the invariant chain (li), which is involved in the formation and transport of MHC-II peptide complexes	43
CD8	cluster of differentiation 8, transmembrane glycoprotein serving as co-receptor for the T cell receptor, which bind together to peptide MHC class-I molecule complexes	4
CD8 T cell	$CD8\alpha^+$ T cell, cytotoxic T lymphocyte expressing the $CD8\alpha^+$ surface protein	4
CD86	cluster of differentiation 86, protein expressed on antigen-presenting cells that provides co-stimulatory signals necessary for T cell activation and survival	38
CFSE	carboxyfluoresceine succinimidyl ester, fluorescent cell staining used in flow cytometry, CAS 92557-81-8	10
CHAPS	3-[(3-Cholamidopropyl)dimethylammonio]-1-propanesulfonate hydrate, CAS 331717-45-4	31
CLEM	correlative light and electron microscopy	16
CLL	chronic lymphocytic leukemia, type of cancer characterized by continuous production of certain B lymphocytes by the bone marrow	11
CMV	cytomegalovirus	11
CNS	central nervous system, consist of the nerve cells of the brain and the spinal cord	43
CPRG	chlorophenolred-β-D-galactopyranoside, CAS 99792-79-7	36
CTL	cytotoxic T lymphocyte, T lymphocyte that is able to lyse abnormal cells such as cancer cells, cells that are infected e.g., with viruses, or cells that are aberrant in other ways	4
CuAAC	copper-catalysed alkyne-azide cycloaddition reaction. Reaction between an azide and an alkyne, catalysed by Cu(I)	12
$CuSO_4$	copper(II) sulphate, CAS 7758-98-7	35
CV	column volumes	34
Cy5-alk	cyanine5 fluorophore with an alkyne handle	35
DABCO	1 % 1, 4-Diazabicyclo-octane, 90 % glycerol in phosphate buffer	37

DAPI	4',6-diamidino-2-phenylindole, fluorescent stain that binds strongly to adenine-thymine-rich regions in DNA, used in fluorescence microscopy 27
DC	dendritic cell 3
ddH_2O	double-distilled water, purified water 56
DIPEA	N,N-diisopropylethylamine, CAS 7087-68-5 74
DL-18	dominant $CD4^+$ T_{helper} cell epitope (MHC-II) of the ovalbumin protein, residues 247-264, DEVSGLEQLESIINFEKL 24
DMEM	Dulbecco's Modified Eagle Medium 32
DMF	dimethylformamide, CAS 68-12-2 74
DMSO	dimethyl sulfoxide, CAS 67-68-5 35
DNA	deoxyribonucleic acid 10
DNase-I	endonuclease that cleaves DNA 33
DTT	1,4-dithiothreitol, CAS 3483-12-3 31
E. coli	*Escherichia coli*, is a gram-negative, rod-shaped, facultative anaerobic, coliform bacterium of the genus *Escherichia* that is commonly found in the lower intestine of warm-blooded organisms 15
EAE	experimental autoimmune encephalomyelitis, is an animal model for brain inflammatory diseases including demyelination around the nerve cells of the CNS 11
ECL	enhanced chemiluminescent 33
EDTA	ethylenediaminetetraacetic acid, chelating agent to catch metal ions, CAS 6381-92-6 31
ELISA	enzyme-linked immunosorbent assay, analytical biochemistry assay to measure levels of antibodies or proteins in biological samples ... 10
ELISpot	enzyme-linked immune absorbent spot assay, antibody based detection assay that focuses on quantitatively measuring the frequency of cytokine secretion for single cells 10
eq	equivalence 74
ER	endoplasmic reticulum, cell organelle forming the transport system of the cell with major involvement in protein folding 7
FCS	fetal calf serum 32
FCS HI	HyClone™ fetal calf serum 32
Fmoc	9-fluorenylmethyloxycarbonyl chloride, CAS 28920-43-6 73

G. gallus	*Gallus gallus*, chicken	33
GAG	glycosaminoglycan	7
GP	glycoprotein	71
H_2O	water	76
H-NMR	proton nuclear magnetic resonance spectroscopy	35
HBTU	O-benzotriazol-1-yl-N,N,N,N-tetramethyluronium hexafluorophosphate, CAS 94790-37-1	74
HCl	hydrochloric acid, CAS 7647-01-0	32
HEL	hen egg lysozyme	43
Hepes	4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid, buffer, CAS 7365-45-9	32
His_6	polyhistidine-tag consisting of 6 histidines, for affinity purification of polyhistidine-tagged recombinant proteins expressed in prokaryotic expression systems	20
HLA-DM	human leukocyte antigen-DM, human intra-endo-lysosomal protein assisting in peptide loading of major histocompatibility complex class-II molecules in dendritic cells, macrophages and B cells by releasing CLIP	6
Hpg	homopropargylglycine, non-canonical amino acid	15
HPLC	high-performance liquid chromatography	71
HPV	human papillomavirus	11
HRP	horseradish peroxidase, enzyme used in enhanced chemiluminescence to catalyse the oxidation of luminol	9
HSV GP	herpes simplex virus glycoprotein B	10
HSV-1	herpes simplex virus-1	10
HSV2.3.2E2	herpes simplex virus-1 specific T cell hybridoma cross-presenting glycoprotein B epitope (497-505, SSIEFARL) presented on MHC-I	72
ICS	intracellular cytokine staining, flow cytometry based assay that detects the production and accumulation of cytokines	10
iEDDA	inverse electron demand Diels-Alder reaction	14
IEP	the isoelectric point, or pH(I), pH at which a molecule in aqueous solution carries no net electrical charge	17
IFN-γ	interferon-γ, pro-inflammatory cytokine secreted by lymphocytes of the adaptive immune system	10

IgD	monomeric immunoglobulin isotype co-expressed with IgM 43
IGEPAL	IGEPAL CA-630, NP-40, non-ionic, non-denaturing detergent...... 31
IgG	mostly monomeric and most abundant immunoglobulin isotype... 31
IgM	pentameric immunoglobulin isotype and the first to appear in the response to initial exposure to an antigen 43
Ile	isoleucine, amino acid, I 4
IMDM	Iscove's Modified Dulbecco's Medium 32
IPTG	isopropyl-β-D-1-thiogalactopyranoside, CAS 367-93-1.............. 21
IS	immune system 3
KOCN	potassium cyanate, CAS 590-28-3 56
LacZ	gene in the lac operon that encodes for β-galactosidase 21
LAMP-1	lysosomal-associated membrane protein-1, cluster of differentiation 107a, transmembrane glycoprotein located across lysosomal membranes 27
LB	lysogeny broth, enriched bacterial growth medium.................. 33
LC-MS	liquid chromatography-mass spectrometry 35
li	polypeptide important for the stability of MHC class-II before the specific peptide loading 43
LN	lymph node, organ of the lymphatic system and important meeting point of T cells, B cells and dendritic cells............................ 4
LPS	lipopolysaccharide 27
Ly5.1	congenic marker also known as cluster of differentiation 45.1 38
M. barkeri	*Methanosarcina barkeri* 15
M. jannaschii	Methanococcus jannaschii 15
M. mazei	Methanosarcina mazei 15
M6P	mannose-6-phosphate, moiety to target the pro-enzyme to the endolysosome.. 7
mAb	monoclonal antibody 20
ManNAz	azide-modified mannosamine 12
MBP	myelin basic protein, major constituent of the myelin around oligodendrocytes and Schwann cells in the central nervous system 7
MBP_{85-99}	myelin basic protein peptide, myelin basic protein auto-antigen peptide relevant in multiple sclerosis, VVHFFKNIVTPRTPP 60

MEM	minimal essential medium	32
MeOH	methanol, CAS 67-56-1	36
MES	2-(N-morpholino)ethanesulfonic acid, CAS 4432-31-9	31
met^{aux}	methionine auxotroph, amino acid auxotrophy is the inability of an organism to synthesize particular amino acid(s) required for its growth	15
$MgCl_2$	magnesium chloride, CAS 7791-18-6	77
MHC	major histocompatibility complex	3
MHC-I	major histocompatibility complex class-I	4
MHC-II	major histocompatibility complex class-II	4
MOG	myelin oligodendrocyte glycoprotein, glycoprotein involved in the myelination of nerves in the central nervous system	60
MS	mass spectrometry is an analytical technique that is used to study biomolecules by measuring the mass-to-charge ratio of ions	8
MSP	monosodium phosphate, CAS 7558-80-7	32
MTB	*Mycobacterium tuberculosis*, pathogenic bacterium and the causative agent of the lung disease tuberculosis	3
Nacitrate	sodium citrate, CAS 68-04-2	57
NaCl	sodium chloride, CAS 7647-14-5	32
NaH_2PO_4	monosodium phosphate buffer in different molarities used e.g., for purification of proteins or culture media, CAS 7558-80-7	32
NaOAc	sodium acetate, CAS 127-09-3	55
NaOH	sodium hydroxide, CAS 1310-73-2	32
neAA	non-essential amino acids	32
NEPTM	non-enzymatic post-translational modification	54
NFAT	nuclear factor of activated T cells, family of transcription factors implicated in the control of cytokine and early immune response gene expression	10
$NH_4CH_3CO_2$	ammonium acetate, CAS 631-61-8	35
Ni-NTA	nickel nitrilotriacetic acid resin, nickel-charged affinity resin for purification of recombinant proteins equipped with a poly-histidine sequence	31
NP-40	nonidet P-40, IGEPAL CA-630, non-ionic and non-denaturing detergent, CAS 9016-45-9	77

OD_{600}	optical density measured at a wavelength of 600 nm	33
OT-I	T cell receptor transgenic T cells, which produce MHC class I-restricted, ovalbumin-specific, $CD8a^+$ T cells	27
OT-II	T cell receptor transgenic T cells, which produce MHC class II-restricted, ovalbumin-specific, $CD4^+$ T cells	27
PAD4	protein arginine deiminase 4, enzyme capable of converting positively charged arginine into neutral citrulline.	41
PBA	phosphate buffered saline with (bovine) serum albumin protein	36
PBAS	phosphate buffered saline with 1 w/v % bovine serum albumin and 0.5 w/v % saponin	36
PBS	phosphate-buffered saline, water-based salt solution for maintaining pH	32
PBST-20	phosphate buffered saline with 0.05% Tween-20	37
pen	penicillin antibiotic used in mammalian cell culture media to prevent contamination	32
PFA	paraformaldehyde, fixative, preserves biological material in its current state by preventing autolysis and putrefaction	27
Pg	propargylglycine, non-canonical amino acid	70
PLC	peptide loading complex	6
PLCP	papain-like cysteine protease	6
PMA	phorbol 12-myristate 13-acetate, CAS 16561-29-8	31
pMHC	peptide-major histocompatibility complex	4
POI	protein of interest	55
PTM	post-translational modification	6
PVDF	polyvinylidene difluoride, membrane	34
RA	rheumatoid arthritis	4
rmGM-CSF	recombinant mouse granulocyte-macrophage colony-stimulating factor, immune-modulatory cytokine and used to differentiate phenotype of myeloid lineage cells into antigen presenting dendritic cells	31
RNase-A	RiboNuclease-A, best characterized member of the RNase family of nucleases that catalyse the degradation of RNA	60
RNase-S	RiboNucleAse-S, peptide-protein complex of S-peptide and S-protein of the RNase family	60
RPMI	Roswell Park Memorial Institute Medium 1640	32

rt	room temperature	34
SB	sample buffer	32
SD	standard deviation, is a measure of the amount of variation within a set of values	29
SDS-PAGE	sodium dodecyl sulphate-polyacrylamide gel electrophoresis	9
sec	second(s)	34
Ser	serine, amino acid, S	4
SiaNAz	azide-modified sialic acid	12
SL-8	dominant CD8α^+ T cell epitope (MHC-I H-2K*b* restricted) of the ovalbumin protein, residues 256-264, SIINFEKL	24
SLP	synthetic long peptide, linear poly peptide of up to 40 amino acids	71
SPAAC	strain-promoted azide-alkyne cycloaddition	14
SPPS	solid phase peptide synthesis	73
strep	streptomycin used in mammalian cell culture media to prevent contamination	32
T cell	T lymphocyte, type of white blood cell, that plays a central role in cell-mediated immunity and mature in the thymus	3
T_h cell	$CD4^+$ T_{helper} cell, important T cell type of the adaptive immune system helping to coordinate other immune cells by releasing tailor-made cytokine cocktails to combat invaders	4
T_h epitope	T_{helper} epitope, epitope recognized by $CD4^+$ T cells called helper T cells which activate B cells, macrophages and cytotoxic T cells.	32
T1D	type-1 diabetes, chronic auto-immune disease and a form of diabetes where destruction of insulin-producing pancreatic β-cells is the reason for insulin deficiency	4
TAMRA-az	5-(and-6)-carboxytetramethylrhodamine, succinimidyl Ester (5(6)-TAMRA fluorophore with an azide handle	35
TBA	tert-butanol, CAS 75-65-0	76
TBS	tris-buffered saline	55
TCEP	tris(2-carboxyethyl)phosphine, CAS 51805-45-9	35
TEV	tobacco etch virus endopeptidase, highly sequence-specific cysteine protease	20
TFA	trifluoroacetic acid, CAS 76-05-1	75

THP-1	Tohoku Hospital Pediatrics-1, human monocytic T cell line, ATCC® TIB-202™	38
THPTA	tris-hydroxypropyltriazolylmethylamine	35
TIPS	triisopropyl silane, CAS 6485-79-6	75
TLR	Toll-like receptor	7
ToF-MS	time-of-flight mass spectrometry, method of mass spectrometry offering unlimited mass range and the possibility of obtaining extremely rapidly mass spectra over a broad ion mass range	21
Tris	tris(hydroxymethyl)aminomethane hydrochloride, CAS 1185-53-1	32
tRNA	transfer RNA, serves as the physical link between the messenger RNA and the amino acid sequence of proteins	15
Trp	tryptophan, amino acid, W	4
TTcF	tetanus toxin C-fragment	7
TTMA	(Tris((1-((O-ethyl)carboxymethyl)-(1,2,3-triazol-4-yl))methyl)amine	35
UAA	unnatural amino acid or non-canonical amino acid, ncAA	15
Val	valine, amino acid, V	4