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Bioorthogonal antigens as tool for investigation of antigen processing and presentation

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$\Delta\epsilon$	difference between the absorption of left-handed (ϵ_R) and right-handed (ϵ_L) circularly polarized light in CD	34
θ	molar ellipticity, $\text{deg cm}^2 \text{ dmol}^{-1} = \Delta\epsilon$	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

List of Abbreviations

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	<i>Clostridium histolyticum</i> , gram-positive bacterium causing e.g., gas gangrene found in soil and feces	31
C. jacchus	<i>Callithrix jacchus</i> , 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	<i>Chlamydia pneumoniae</i> , 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 (Ii), 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 α^+ T cell, cytotoxic T lymphocyte expressing the CD8 α^+ 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

List of Abbreviations

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 ₂ O	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	<i>Escherichia coli</i> , is a gram-negative, rod-shaped, facultative anaerobic, coliform bacterium of the genus <i>Escherichia</i> 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-fluorenylmethoxycarbonyl chloride, CAS 28920-43-6.....73

G. gallus	<i>Gallus gallus</i> , chicken.....	33
GAG	glycosaminoglycan.....	7
GP	glycoprotein.....	71
H ₂ O	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 pI(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

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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	<i>Methanosarcina barkeri</i>	15
M. jannaschii	<i>Methanococcus jannaschii</i>	15
M. mazei	<i>Methanosarcina mazei</i>	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	<i>Mycobacterium tuberculosis</i> , 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 ₂ PO 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 ₄ CH ₃ CO 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

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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, CD8 α^+ 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 CD8 α^+ T cell epitope (MHC-I H-2Kb 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

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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