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Superlattices in van der Waals materials: a low-energy electron microscopy study

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LIST OF PUBLICATIONS

13. T. A. de Jong et al. LEEM study of Charge Density Waves in mixed polytype TaS₂. *in preparation* (2022)
12. G. Gatti, J. Issing, L. Rademaker, F. Margot, T. A. de Jong, S. J. van der Molen, J. Teyssier, T. Kim, M. D. Watson, C. Cacho, K. Cordero Edwards, P. Paruch, N. Ubrig, I. Gutiérrez-Lezama, A. Morpurgo, A. Tamai & F. Baumberger. Observation of flat bands in twisted bilayer WSe₂. *in preparation* (2022)
11. J. Jobst, E. E. Krasovskii, R. Ribeiro, T. A. de Jong, C. R. Dean, R. M. Tromp & S. J. van der Molen. Evolution of the unoccupied bands in the series of MoX₂ Transition Metal Dichalcogenides (X = S, Se, Te). *in preparation* (2022)
10. T. A. de Jong, X. Chen, E. E. Krasovskii, R. M. Tromp, J. Jobst & S. J. van der Molen. Low-Energy Electron Microscopy contrast of stacking boundaries: comparing twisted few-layer graphene and strained epitaxial graphene on silicon carbide. *under review*. <https://arxiv.org/abs/2207.14616> (2022)
9. T. A. de Jong, L. Visser, J. Jobst, R. M. Tromp & S. J. van der Molen. Stacking domain morphology in epitaxial graphene on silicon carbide. *under review*. <https://arxiv.org/abs/2207.14623> (2022)
8. T. A. de Jong, T. Benschop, X. Chen, E. E. Krasovskii, M. J. A. de Dood, R. M. Tromp, M. P. Allan & S. J. van der Molen. Imaging moiré deformation and dynamics in twisted bilayer graphene. *Nature Communications* **13**, 70. doi:[10.1038/s41467-021-27646-1](https://doi.org/10.1038/s41467-021-27646-1) (2022)
7. T. Benschop*, T. A. de Jong*, P. Stepanov*, X. Lu, V. Stalman, S. J. van der Molen, D. K. Efetov & M. P. Allan. Measuring local moiré lattice heterogeneity of twisted bilayer graphene. *Physical Review Research* **3**, 013153. doi:[10.1103/PhysRevResearch.3.013153](https://doi.org/10.1103/PhysRevResearch.3.013153) (2021)
6. S. Lisi*, X. Lu*, T. Benschop*, T. A. de Jong*, P. Stepanov, J. R. Duran, F. Margot, I. Cucchi, E. Cappelli, A. Hunter, A. Tamai, V. Kandyba, A. Giampietri, A. Barinov, J. Jobst, V. Stalman, M. Leeuwenhoek, K. Watanabe, T. Taniguchi, L. Rademaker, S. J. van der Molen, M. P. Allan, D. K. Efetov & F. Baumberger. Observation of flat bands in twisted bilayer graphene. *Nature Physics* **17**, 189–193. doi:[10.1038/s41567-020-01041-x](https://doi.org/10.1038/s41567-020-01041-x) (2021)
5. T. A. de Jong, D. N. L. Kok, A. J. H. van der Torren, H. Schopmans, R. M. Tromp, S. J. van der Molen & J. Jobst. Quantitative analysis of spectroscopic low energy electron microscopy data: High-dynamic range imaging, drift correction and cluster analysis. *Ultramicroscopy* **213**, 112913. doi:[10.1016/j.ultramic.2019.112913](https://doi.org/10.1016/j.ultramic.2019.112913) (2020)
4. C. B. Smiet, H. J. de Blank, T. A. de Jong, D. N. L. Kok & D. Bouwmeester. Resistive evolution of toroidal field distributions and their relation to magnetic clouds. *Journal of Plasma Physics* **85**. doi:[10.1017/S0022377818001290](https://doi.org/10.1017/S0022377818001290) (2019)
3. T. A. de Jong, J. Jobst, H. Yoo, E. E. Krasovskii, P. Kim & S. J. van der Molen. Measuring the Local Twist Angle and Layer Arrangement in Van der Waals Heterostructures. *physica status solidi (b)* **255**, 1800191. doi:[10.1002/pssb.201800191](https://doi.org/10.1002/pssb.201800191) (2018)

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2. T. A. de Jong, E. E. Krasovskii, C. Ott, R. M. Tromp, S. J. van der Molen & J. Jobst. Intrinsic stacking domains in graphene on silicon carbide: A pathway for intercalation. *Physical Review Materials* **2**, 104005. doi:[10.1103/PhysRevMaterials.2.104005](https://doi.org/10.1103/PhysRevMaterials.2.104005) (2018)
1. J. J. T. Wagenaar, A. M. J. den Haan, J. M. de Voogd, L. Bossoni, T. A. de Jong, M. de Wit, K. M. Bastiaans, D. J. Thoen, A. Endo, T. M. Klapwijk, J. Zaanen & T. H. Oosterkamp. Probing the Nuclear Spin-Lattice Relaxation Time at the Nanoscale. *Physical Review Applied* **6**, 014007. doi:[10.1103/PhysRevApplied.6.014007](https://doi.org/10.1103/PhysRevApplied.6.014007) (2016)