Physikalisches Kolloquium Physics Colloquium

Einladung Invitation

Monday, 04 July 2022

Format: Online via ZOOM, at 16:15

Transmission electron microscopy: a flexible technique for in-situ (3D) atomic resolution characterization of 2D materials and nanoparticles catalysts.

Professor Sarah Haigh

University of Manchester,
Department of Materials, UK
www.research.manchester.ac.uk

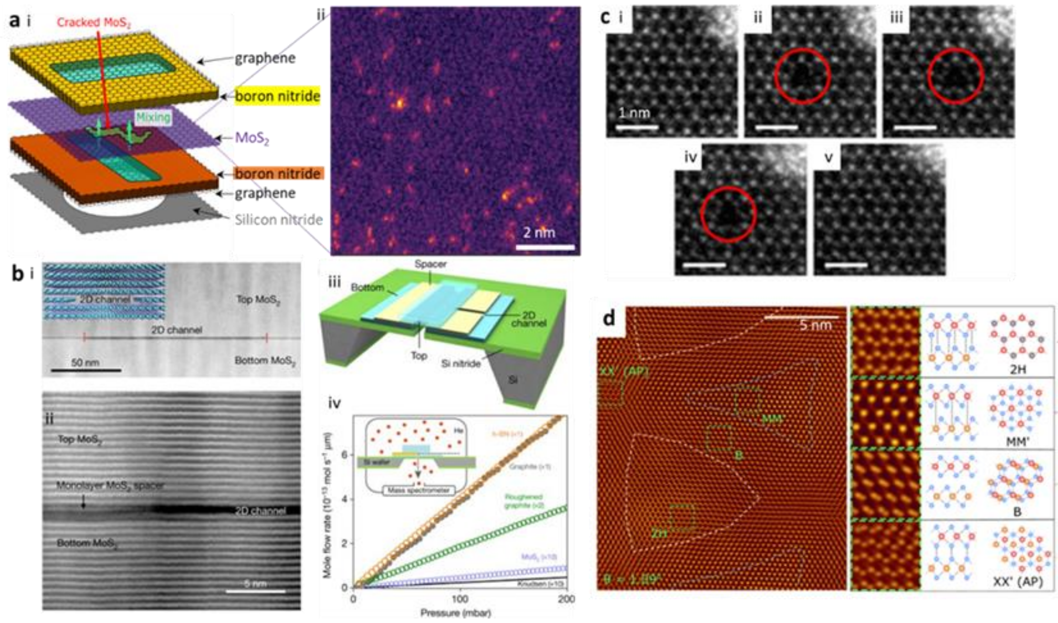
This talk presents recent work at the University of Manchester using atomic resolution scanning transmission electron microscope (STEM) imaging to accelerate the development of nanoparticle catalysts and 2D materials that support the move to net zero energy. In particular the possibility to create new 'designer' materials by stacking together atomically thin 2D layers has opened up a huge range of opportunities for low power electronics, from new optoelectronic phenomena [1] to quantum devices harnessing interactions in moiré superlattices [2], as well as enabling improved understanding of gas/liquid flow inside fuel cell and water filtration membranes [3,4]. The impressive progress being achieved in the field crucially depends on knowledge of the atomic structure of these heterostructures [4,5], which in many cases can only be analysed by transmission electron microscopy (TEM) techniques. I will demonstrate imaging of the unusual lattice reconstruction that occurs in twisted transition metal dichalcogenide bilayers [6] as well as how this can be modified by the application of fields within the electron microscope.[7]

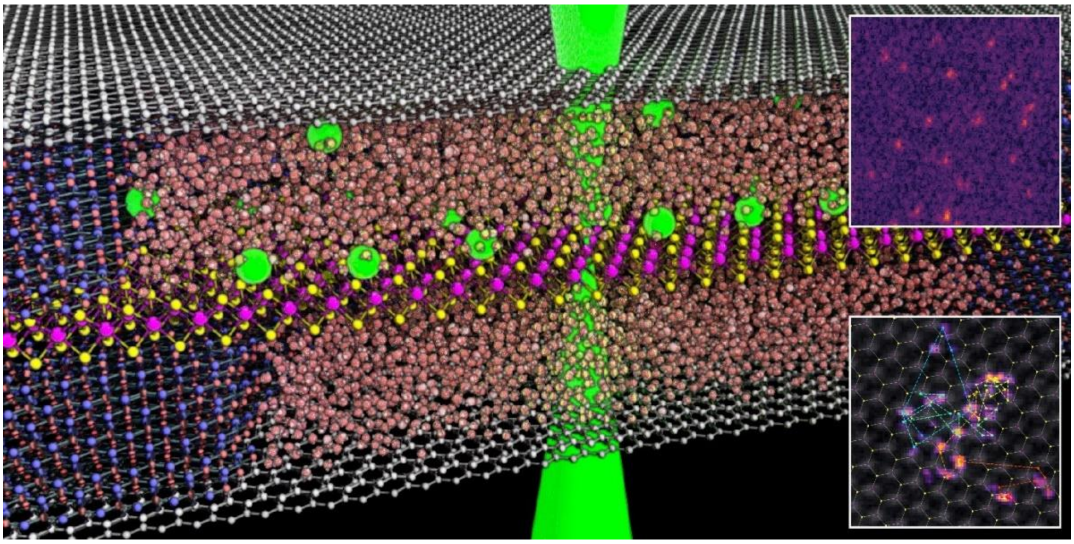
I will also illustrate recent examples where we have used 2D heterostructures to produce a new design of in-situ cell [8,9]. This approach allows direct visualisation of the earliest stages of liquid mixing reactions (exemplified by our study of calcium carbonate precipitation [8]) as well as atomic resolution imaging of adatom dynamics at solid-liquid interfaces [9]. I will also discuss in situ 3D elemental TEM imaging of catalytic nanoparticles [10], combining information from hundreds of similar particles to gain a quantitative elemental distribution in an approach similar to that used for structural solutions of proteins via cryo-transmission electron microscopy.

References:
[1] J. Zultak et al, Nature Communications 11 (1), 1-6 (2020), [2] R. Krishna-Kumar et al, Science 357, 181-184 (2017); [3] B. Radha et al. Nature 538, 222–225 (2016) and Keerthi, et al Nature 558 (7710), 420-424. (2018) [4] Zou et al, Nature Materials, (2021), 20, 1677–1682 [5] D. Hopkinson et al ASC Nano 13 (5), 5112-5123 (2019) and M. Hamer et al, Nano Letters, 20, 9, 6582–6589 (2020), [6] A. Weston et al Nature Nanotechnology, 15 592–597 (2020), [7] A. Weston et al Nature Nanotechnology (2022), 17, 390–395 [8] D. Kelly, et al Advanced Materials, 2021, [9] N Clark et al Nature 2022 (in press). [10] Wang et al Nano Letters (2019) 19, 2, 732–738 and Leteba et al, Nano Letters (2021), 21, 9, 3989–3996

Host: Prof. Dr. Ute Kaiser, Electron Microscopy Group of Materials Science

Organisation: Prof. Dr. Jens Michaelis, Institute of Biophysics, jens.michaelis@uni-ulm.de, +49-731-50-23050





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