Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

Wednesday, March 2nd 2022 – 14:00
CFEL Seminar room I/II/III (Bldg. 99) and on Zoom*

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Defect and nanopore engineering of 2D films

Atomically thin films, such as molybdenum disulphide (MoS2) and hexagonal boron nitride (hBN) are widely used across many research fields to study nanoscale physics of nanoelectronic, photonic or nanofluidic applications. From top-down synthesis to bottoms-up nanofabrication, the properties of studied systems are intrinsically connected to their z-dimensions and geometrical structure. The aim of this work is to develop a large-area, robust synthesis and fabrication method and create an upscalable experimental platform for studying and developing nanodevices. Metallorganic chemical vapor deposition systems are used to synthesize large-area monolayer MoS2 films on 3- and 4- inch wafer scale to achieve a large-batch material supply. Xe-ion PFIB is used to fabricate nanopores on suspended monolayer membranes with sub-nm precision. Established irradiation protocol enables fine-tuning of pore dimensions and geometries to study ion and fluid flow through confined structures in applications such as salinity-gradient power generation and biosensing. PFIB patterning is also used to demonstrate the large-area defect engineering of exfoliated MoS2 and hBN multilayers with high spatial control to explore fluorescent defects and single photon emitters. The defect/nanopore engineering methodology shown here allows to create fine and precise negative nanostructures, crucial in studying properties and nanoscale physics of 2D materials.

Michal is an engineer and materials scientist specializing in 2D materials, membrane devices, nanofluidics, and blue energy harvesting. About to obtain a Ph.D. from Ecole Polytechnique Federale de Lausanne in Switzerland, he is combining solid-state physics, nanofabrication, and defect engineering to study 2D-nanopores and functional surface coatings. His main fields of interest are nanomaterials synthesis processes and renewable energy applications using suspended nanoporous 2D membranes.

Host: Philip Moll

* https://www.mpsd.mpg.de/events/30386/2736

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