Shedding Light on the Influence of He Ion Irradiation on the Behaviour of MoS_2 and $PtSe_2$

Adeel Bukhari[1,2]
Luka Pirker[1], Gregor Hlawacek[3], Otakar Frank[1]
[1] *J. Heyrovský Institute of Physical Chemistry, Czech Academy of Sciences, Prague, Czech Republic*
[2] *Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic*
[3] *Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany*
adeel.bukhari@jh-inst.cas.cz

Structural defects in two-dimensional materials (2DM) present an as of yet unanswered question in terms of their influence on the properties of materials. Since the concentration of defects present in a 2DM has been shown to impact their behaviour, creating defect-engineered 2DMs provides another avenue towards devices tailor-made for specific applications.[1] Here we introduce defects in precise positions, with controlled fluences, in monolayers of molybdenum disulfide (MoS_2) and platinum diselenide ($PtSe_2$) using helium ion microscopy.[2] We characterise the dependence of the optical, electrical, and mechanical properties of the 2DM on the concentrations of defects created with a range of methods that include optical spectroscopies and atomic force microscopy-based methods such as kelvin probe force microscopy.[3] Gaining further insight into the role that structural defects play in determining the behaviour of a 2DM brings us one step closer to rational design when it comes to tailoring the properties of defect-engineered 2DMs.

References

[1] S. Mignuzzi, A. Pollard et al. Phys. Rev. B 91 (2015) 195411
[2] S. Kretschmer, M. Maslov et al. ACS Appl. Mater. Interfaces 36 (2018) 30827
[3] J. Li, T. Joseph et al. Adv. Funct. Mater. 18 (2022) 2110428

Figures

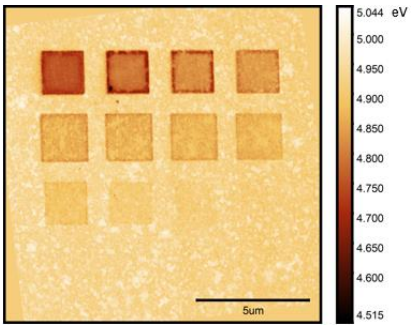

Figure 1: Work function map of a monolayer of MoS_2; dark squares represent greater defect density.

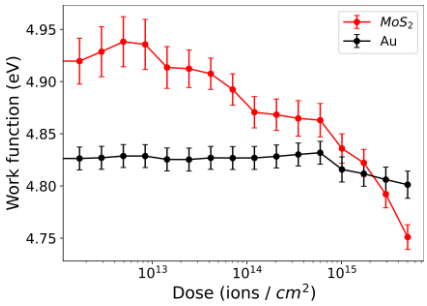

Figure 2: Work function dependence of an MoS_2 monolayer on Au, on dose of helium ion irradiation.