Environmental and defect-induced properties of MoS_2 time-resolved photocurrent and persistent photoconductivity

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Owing to its excellent optoelectronic properties, such as tunable bandgap, low dark current, and high on/off ratio, MoS_2 has been a widely studied material to explore its capabilities in photocurrent generation. Numerous reports present time-resolved photocurrent, usually distinguishing two exponential components attributed to the photoconductive effect (fast) and photogating effect (slow)[1,2]. We have recently proposed a new model of description of the photocurrent in the time domain that divides the photogating effect into two separate effects originating from environmental influence and intrinsic properties such as defects in the crystal lattice[3]. In this communication, we use the previously established model to study the photoresponse of MoS_2 under gate bias in a vacuum and air environment. We also modify the layers, introducing more defects in the material using plasma to study their influence on optoelectronic properties of the layers and how they affect the occurring effect of persistent photoconductivity.

The findings of this work are relevant to understanding the mechanisms of photoconductivity in MoS_2 and enabling controllable modification of the layers by defects, their passivation, or attachment of molecules to the dangling bonds.

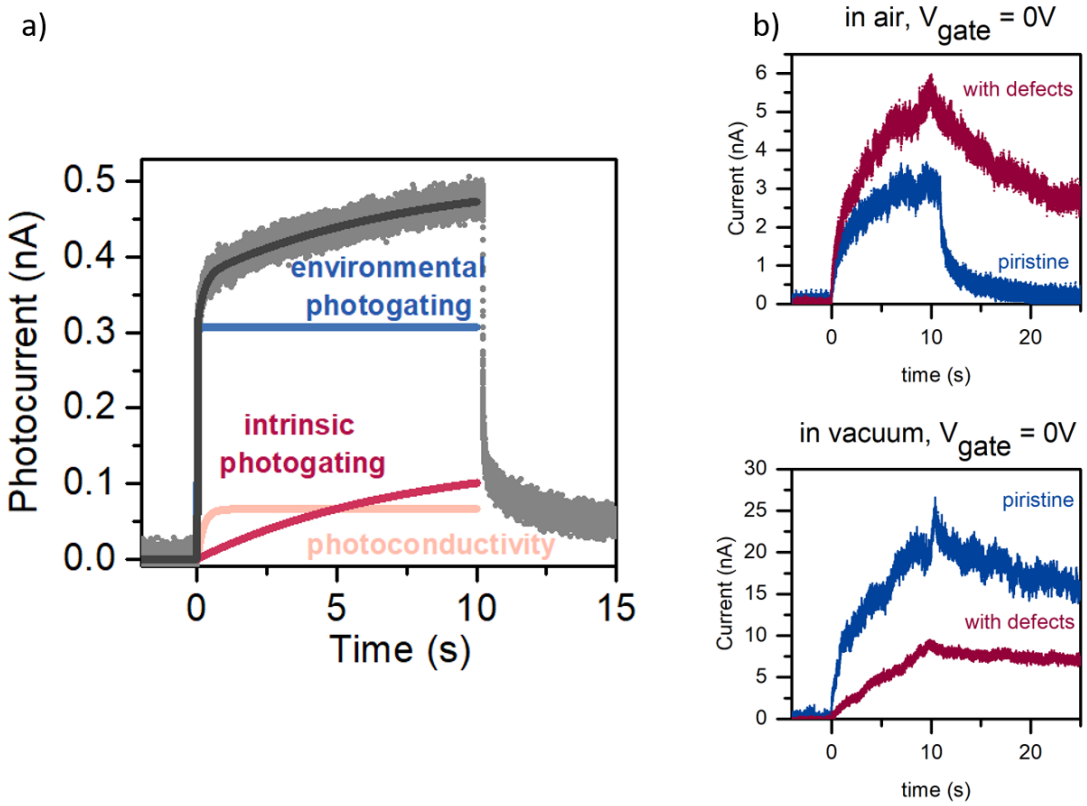

Figure 1 a) The 3-component model fitted to time-resolved photocurrent signal. b) A comparison of the pristine monolayer MoS_2 and the sample after defect introduction in air and vacuum.

[1] M. M. Furchi, et al., Nano letters 14.11, 6165-6170 (2014).
[2] A. Di Bartolomeo, et al., Nanotechnology 28.21, 214002 (2017).
[3] K. Czerniak-Łosiewicz, et al., J.Phys.Chem.C 124, 18741−18746 (2020).