Optical writing of electric states in 2D/ferroelectric -photovoltaic structures.

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This PhD subject is an excellent opportunity that unites experimental studies in the areas of two dimensional materials, ferroelectricity and photovoltaics. Thanks to a single-atom structure, the two dimensional ('2D') materials are very sensitive to the presence of nearby electric charges and can be used to detect and study small changes in polarization (electric state) of the attached material. One the other hand ferroelectric (FE) materials can change their electric state (polarization) under illumination. Therefore, combining unique electronic properties of the 2D materials [1] with such FE compounds can prone to electro-optical and even all-optical atomic scale devices control. While the electrical control has already been demonstrated in such heterostructures for the both bulk [2] and surface [3] configurations the optical one is much less studied. The purely optical approach, however, represents a promising research direction based on the recently discovered photopolarization effect [4]. At certain conditions the FE material under light can show both light-induced charge generation and relaxation processes. Such interplay can lead to both transient and remanent effects due to intrinsic electric field. The established electro-optical and optical functionality of the type shown in Fig.1 and others will be tested to explore opto-electro-statics in the specially designed nanostructures [5]. The task of PhD student will be to prepare 2D structures and heterostructures over the multifunctional ferroelectric substrates using nanofabrication facilities in a cleanroom environment of the Institute. The electrical, optical (in some cases magnetic) measurements will be then performed by the candidate according to the objectives. The candidate should have an experience in research lab work, good skills in spoken and written French or English and sufficient knowledge of material science. Experience in a cleanroom environment is an advantage.

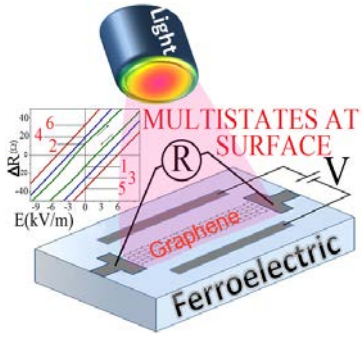

Figure 1: Schematic illustration of the electrooptical control of low dimensional structure using ferroelectric substrate.

Literature

[1] K. S. Novoselov, et al. Science, 353, 9439 (2016).
[2] G. –X. Zheng, et al., Phys. Rev. Lett. 105, 166602 (2010).
[3] V. Iurchuk, H. Majjad, F. Chevrier, D. Kundys, B. Leconte, B. Doudin, B. Kundys, Appl. Phys. Lett. 107, 182901 (2015).
[4] A. S. Makhort, F. Chevrier, D. Kundys, B. Doudin, B. Kundys, Phys. Rev. Materials 2, 012401(R)(2018).
[5] https://arxiv.org/abs/2003.08432