Electro-optical functionalities in 2D/ferroelectric-photovoltaic structures

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This PhD subject is an excellent opportunity which 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 even small changes in polarization (electric state) of the attached material. One the other hand certain ferroelectric (FE) materials can be photovoltaic and 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 is a very promising research direction. At certain conditions the FE material under light can show a complex response including the both light-induced charge generation and relaxation processes. Such an interplay can lead to transient and even remanent effects due to the intrinsic electric field. In this PhD thesis the established electro-optical and optical functionality of the type shown in Fig.1 and similar will be tested to explore opto-electro-statics in the designed nanostructures. The task of PhD student will be to prepare 2D structures and heterostructures over the multifunctional ferroelectric substrates using nanofabrication facilities of the clean room 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 clean room environment is an advantage.

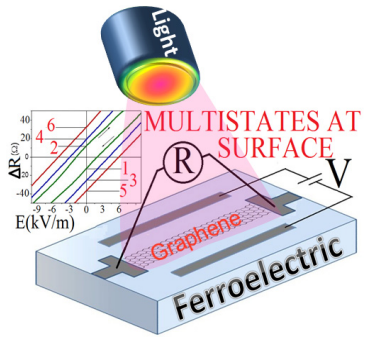

Figure 1: Schematic illustration of the electrooptical control of low dimensional structure using ferroelectric substrate.

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).

Further reading:
[4] https://arxiv.org/abs/1609.01223
[5] https://arxiv.org/abs/2003.08432
[6] https://arxiv.org/abs/1609.01223