Photo-ferroelectric optical transistor

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This PhD subject is an excellent opportunity which unites experimental studies in the, ferroelectricity (FE) and photovoltaics (PV) for development of all-optical computing. In the same way as electrical transistor revolutionized electronics, the discovery of optical transistor should open a whole new era of photonic devices for superior data processing possibilities. This PhD project therefore focuses on the development of an optical way to process optical signal to mimic a function of electrical transistor to be used in computing and beyond. At certain conditions the FE material under light can show a complex response including the both light-induced charge generation and depolarization processes. Such interplay can lead to transient and even remanent optical effects due to the intrinsic electric field evolution (Fig.1). Because of electro-optic effect existence any change in the electric state of the sample should lead to the light transmission modulation via refraction. Another attractive possibility will be to verify device compatibility with neuromorphic functions found in nature. To meet miniaturization requirements the structures containing the two dimensional ('2D') materials will be used due to their sensitivity to nearby electric charges. They will be tested as both: FE environments and optical components for combining their unique electronic properties with FE for electro-optical and even all-optical atomic scale devices control. 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.

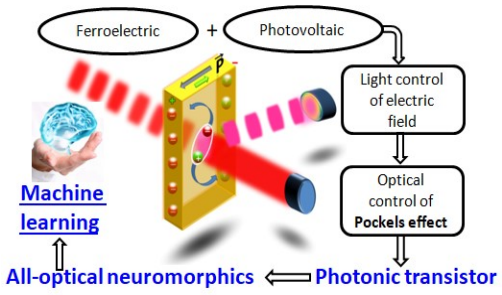

Figure 1: Schematic illustration of the electro-optical control using photo-ferroelectric material. Charge generation impacts electric field and modulates transmitted red beam.

Literature:

[1] https://www.nature.com/articles/nphoton.2009.240

[2] https://arxiv.org/abs/2203.06515

[3] https://arxiv.org/abs/1609.01223

[4] https://arxiv.org/abs/2003.08432

[5] https://arxiv.org/abs/1609.01223