Photoferroelectric photonic devices

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Imagine your computer starting instantly and performing logic operations at the speed of light without overheating. Although this sounds as a science fiction today, it can be become reality soon, by replacing electrical computing with optical computing. To make this happen the photonic processors must be realized. The building blocks for such processors are photonic devices capable to modulate signal light beam. In the same way as electrical transistor revolutionized electronics, the discovery of photonic transistor should open a whole new era of photonic devices for superior data processing possibilities. Your PhD work will help to advance the area of optical computing by developing new type of photonic devices uniting experimental studies in the area of ferroelectricity (FE) and photovoltaics (PV). 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 brain tissues. 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 photonic structures and heterostructures over the multifunctional ferroelectric layers 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 optics and in a clean room environment will be an advantage.

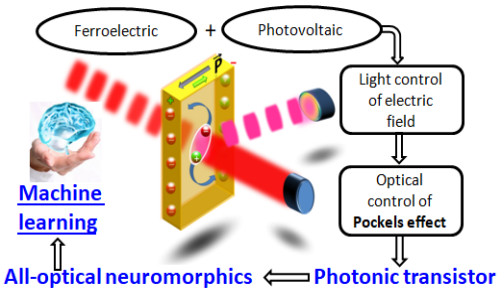

Figure 1: Schematic illustration of the electro-optical control using photo-ferroelectric material. Charge generation impacts electric field and modulates transmitted red beam.

Literature:

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

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

[3] https://arxiv.org/abs/2401.01679

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

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