Integration of ferroelectrics, plasmonic nanostructures and 2D materials for application for nanophotonics

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Layered transition metal dichalcogenides (TMDs) are a fascinating class of atomically thin materials in which d-electrons interactions result in unique physical phenomena, with significant implications across various domains including electronics, spintronics, and optoelectronics. Specifically, monolayer (1L) MoS_2 is currently receiving considerable attention due to its electronic and optoelectronic characteristics as a direct bandgap semiconducting 2D material.

Different physical or chemical strategies can be used to tune the electronic and optical properties of monolayer TMD for diverse optoelectronic applications.
In this study, we present the integration of ferroelectrics, plasmonic nanostructures, and 2D materials into a single monolithic device, achieved without the need for complex processing methods. The mutual interactions among these constituents within the hybrid system is analyzed. Specifically, three main investigations are undertaken: i) the combined impact of ferroelectricity and light on the optoelectronic properties of monolayer MoS_2 deposited on domain-engineered ferroelectric crystals, ii) the optical behavior of MoS_2 deposited on a metallic chain of silver nanoparticles, and iii) the extreme light-matter interaction phenomena to demonstrate pulsed laser operation at the nanoscale [1].

[1] Ramírez M.O. et al (2023) Laser Photonics Rev 2300817, 1–7.

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