Title: ToWards fErroElectricity in Two-dimensions (TWEET)

Source of funding: Ministero dell'Istruzione, dell'Università e della Ricerca (MIUR)

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Project coordinator: S. Picozzi

SPIN coordinator: S. Picozzi

Other partners: CNR-SPIN Napoli, Politecnico Milano, Università Federico II, Napoli

Project objectives.

Inspired by the global thrust towards miniaturization and by the ubiquitous research in 2D-materials, TWEET focuses on ferroelectricity towards the 2D-limit. TWEET is inspired by ferroelectrics (FEs), whose ever-increasing momentum rests on their unique combination of fascinating fundamental physics (microscopic mechanisms leading to FE order and related quantum phenomena), materials science challenges (discovery, design, growth and optimization of novel FEs) and multi-billion-dollar market applications (next-generation non-volatile memories, sensors and actuators). TWEET is also given impetus by the endless demand toward miniaturization and by the mainstream research on 2D-materials, where ferroelectricity was surprisingly almost untouched. By targeting the delivery of technological impact via materials optimization and fundamental understanding of the physics at play in low-thickness FEs, the project goal is to achieve full control of ferroelectricity in few-layers films of CMOS-compatible materials, in order to obtain ad-hoc functional properties, even dramatically different from those of the 3D bulk parent compounds. The team exploits multiple degrees of freedom, not only the dipolar order (characteristic of every FE material), but also its link with phenomena based on spin-orbit-coupling, such as Rashba effects. TWEET is conceived in two pillars. The first is focused on the growth of high-quality HfO_2 ultrathin films, aiming at microscopic understanding and control of the ferroelectric order in static/dynamic regimes, complemented by device exploitation in tunnel barriers. The second focuses on the growth of 2D-chalcogenides (SnTe, GeTe), the ferroelectric control of their spin texture and the exploitation of non-volatile electric tuning of charge/spin transport, based on a novel spin-electric coupling in bulk GeTe. The TWEET vision is based on the synergy of accurate modelling (CNR-SPIN Chieti), highly-controlled synthesis (CNR-SPIN Naples, PoliMi), advanced characterizations (UniNa, CNR-Na, PoliMi) and cutting-edge device implementation (PoliMi).

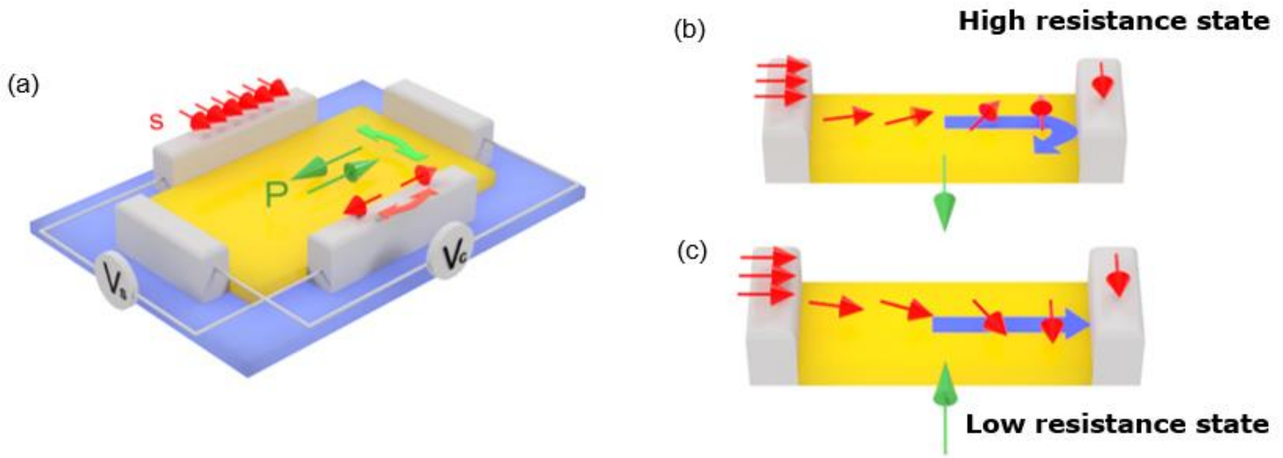

Figure: Spin valve based on Ferroelectric chalcogenides showing Rashba effects.