Super-Lubricant Switching of Coupled Periodic Crystals

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Achieving electric control over switching between distinct crystalline orders is a long-standing goal. Periodic lattice symmetries naturally modify a wide range of material properties; therefore, efficiently switching between them using practical electric fields enables powerful multiferroic functionality. This talk discusses a novel structural transition mechanism between crystalline van der Waals polytypes—superlubric sliding of boundary solitons—identified a few years ago ("SlideTronics", Science, 2021). This mechanism enables electrical switching between numerous polar and semimetallic polytype configurations (Nature, 2022, Nature Reviews Physics, 2024) with an energy cost below 1 fJ per switching event (Nature Nanotechnology, 2026). Such exceptional efficiency is achieved by assembling superlubric arrays of polytypes (SLAP, Nature, 2025), in which nm-scale polytype islands are embedded within superlubric van der Waals interfaces. Beyond their strong appeal for computing technologies, SLAP structures open a unique experimental platform to probe the role of symmetry in electromagnetic responses and to explore fundamental dissipation mechanisms in the ultimate low-friction limit.

Biography

I lead the Quantum Layered Matter Group at Tel Aviv University, where we investigate electronic and structural phases in two-dimensional (2D) materials, primarily through low-temperature transport and surface probe microscopy. Our research is further supported by SlideTro Ltd., a spin-off company dedicated to advancing ferroelectric layered materials for next-generation electronic applications.