Solid-State Lithium-Ion Battery and Supercapacitor Structures for Voltage Control of Magnetism

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Ionic control of magnetism gives rise to high magnetoelectric coupling efficiencies at low voltages [1-3], which is relevant for low-power magnetism-based memory and computing technologies. Unfortunately, magneto-ionic devices do often suffer from slow kinetics, poor cyclability, impractical liquid architectures, or strong ambient effects. As a route to overcoming these problems, I will demonstrate voltage control of magnetism by reversible cycling of Li ions in LiPON-based solid-state ionic batteries and supercapacitors. The following magneto-ionic effects will be presented; (1) reversible switching of magnetization between in plane and perpendicular states in thin Co films [4]; (2) voltage control over the nucleation and annihilation of magnetic skyrmions in $Pt/Co_{40}Fe_{40}B_{20}/Pt$ [5]; and (3) Li-ion-induced manipulation of the Ruderman-Kittel-Kasuya-Yosida (RKKY) interaction in perpendicularly magnetized Co/Pt layers [6]. As key outcomes, I will show that Li-ion-based heterostructures provide remarkably high magnetoelectric coupling efficiency, fast voltage control by 60 μs pulses at room temperature, and excellent device endurance up to 750000 voltage cycles.

References:

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