Seminar

Znanstvenog centra izvrsnosti
QuantiXLie i Fizičkog odsjeka

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Tunnel magnetoresistance effect with a twist: reversible ferroelectric switching of spin polarization in Co/PZT/LSMO

Tunnel magnetoresistance (TMR) elements have recently started replacing the existing sensors in hard disk drives and proved to be excellent angle sensors. In their novel multiferroic version, TMR junctions are characterized by 4 resistance states, instead of standard 2 in magnetic and ferroelectric tunnel junctions. On top of that, recent experiments have shown that in the Co/PbZr_0.2Ti_0.8O_3/La_0.7Sr_0.3MnO_3 multiferroic tunnel junctions (MTJ) it is possible to reversibly switch the sign of the spin polarization of the tunneling electrons by an electric field, indicating technologically promising new ways of spin transport control in spintronic devices. Still, the possible optimization of this effect as well as the application to other MTJ systems is hindered by the lack of understanding of the underlying mechanism. So far, despite the theoretical efforts, the spin inversion with ferroelectric switching has not been explained. In this presentation, I will describe a likely and realistic mechanism explaining the observed ferroelectric switching of spin polarization which we identified using density-functional theory. The explanation is based on an O-vacancy related interface structure, which could be expected at such interfaces. The mechanism we find is based on drastic and reversible changes in the reactivity and chemical binding of the interfacial O with Co upon the inversion of the ferroelectric polarization. The ferroelectric-controllable reactivity of O leads virtually to ON/OFF switchable O-Co hybridization and a swappable spin polarization in the PZT barrier.

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Znanstveni centar izvrsnosti
za kvantne i kompleksne sustave te
reprezentacije Liejevih algebri

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