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Switching Iron-based Superconductivity with Spin Currents

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We have explored a new mechanism for switching magnetism and superconductivity in a magnetically frustrated iron-based superconductor using spin-polarized scanning tunneling microscopy (SPSTM)[1]. Our SPSTM study on single crystal Sr_2VO_3FeAs made of alternating self-assembled FeAs monolayer and Sr_2VO_3 bilayers shows that a spin-polarized tunneling current can switch the FeAs-layer magnetism into a non-trivial C_4 (2×2) order, which cannot be achieved by thermal excitation with unpolarized current. Our tunneling spectroscopy study shows that the induced C_4 (2×2) order has characteristics of plaquette antiferromagnetic order in the Fe layer and strongly suppresses superconductivity. Also, thermal agitation beyond the bulk Fe spin ordering temperature erases the C_4 state. These results suggest a new possibility of switching local superconductivity by changing the symmetry of magnetic order with spin-polarized and unpolarized tunneling currents in iron-based superconductors[2]. We also performed high-resolution quasiparticle interference (QPI) measurements, self-consistent BCS-theory-based QPI simulations and a detailed e-ph coupling analysis to provide direct atomic-scale proofs of enhancement of iron-based superconductivity due to the BCS mechanism based on forward-scattering interfacial phonons[3].

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Biography:

Prof. Jhinhwan Lee grew up in Republic of Korea and received his Bachelor's degree from Seoul National University in 1995. After he obtained his Ph.D. degree from Seoul National University in 2002, he joined Professor J. C. Davis' Laboratory at Cornell University as a Postdoctoral Associate in 2004 and was appointed Research Associate in 2007. Jhinhwan Lee went to Korea Advanced Institute of Science and Technology as Assistant Professor in 2009 and began his life-long investigations on magnetism and unconventional superconductivity. He was awarded with Bombee Physics Award in 2004 and Albert Nelson Marquis Lifetime Achievement Award in 2018.