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Electrically tunable transport in antiferromagnetic Sr_2IrO_4[1]

CHENG WANG, HEIDI SEINIGE, Physics Department, The University of Texas at Austin, GANG CAO, Center for Advanced Materials, University of Kentucky, JIAN-SHI ZHOU, JOHN B. GOODENOUGH, Texas Materials Institute, The University of Texas at Austin, MAXIM TSOI, Physics Department, The University of Texas at Austin — Electronic transport in antiferromagnetic (AFM) Mott insulator Sr_2IrO_4 is studied under high electric fields. Our goal is to address the question of electronic conduction in nano-scale AFM spintronic applications [1] where high biases and associated electric fields are routinely present. We use nano-scale contacts between a sharpened Cu tip and single crystal of Sr_2IrO_4 to achieve electric fields up to a few MV/m. When an electrical bias is applied to such a point contact, the electric potential drops essentially in a small contact region, thus leading to high electric fields and providing a means to probe electronic transport on a microscopic scale. Detailed measurements of point-contact current-voltage characteristics revealed that the contact resistance decreased significantly (50-70%) with an increasing dc bias. The observed bias dependence can be well fitted by an activation energy model that involves band structure modifications under strong electric fields. Our findings suggest a promising path towards band-gap engineering in 5d transition metal oxides, which may lead to appealing technical solutions in developing next generation's electronic devices.

[1] C. Wang et al., Phys. Rev. X, November 2014.

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