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Fabrication of nano-gapped single-electron transistors for transport studies of individual single-molecule magnets CHRISTOPHER RAMSEY, JOHN HEMDERSON, ENRIQUE DEL BARCO, Dept. of Physics, University of Central Florida, ABHUDAYA MISHRA, GEORGE CHRISTOU, Dept. of Chemistry, University of Florida — Three terminal single-electron transistor devices utilizing Al/Al2O3 gate electrodes were developed for the study of electron transport through individual single-molecule magnets (SMMs). These devices were patterned via multiple layers of optical and electron beam lithography. Al gate electrodes were allowed to oxidize in the ambient atmosphere overnight, creating a robust Al2O3 insulating layer. The single-electron transistor devices were then treated with O2 plasma and Mn12-(3-thiophenecarboxylate) SMMs were self-assembled on the surface. These molecules are Mn12-acetate derivatives, which have been functionalized with thiophene groups and are known to attach to Au surfaces. Self-assembly of the molecules was verified using scanning probe microscopy and XPS measurements. Nano-gapped electrodes were produced at low temperature by electromigration of the 90 nm wide Au wire, reliably yielding 1-3 nm gaps in which the SMM can be situated. We show that the nano-gap spacing can be fine tuned by adding resistance in series with the nanowire. Electron transport measurements were then performed to reveal gate dependent low level (less than 40 meV) excitations in the conductance of a single Mn12 SMM.

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