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**Humidity dependence of molecular tunnel junctions with an AlOx/COOH- interface** XIAOHANG ZHANG, STEPHEN MCGILL, PENG XIONG, Physics Department & MARTECH, Florida State University, Tallahassee, FL — We have studied the electron transport in planar tunneling junctions with aluminum oxide and an organic self-assembled monolayer (SAM) as the tunnel barrier. The structure of the junctions is Al/AlOx/SAM/(Au, Pb) with a junction area of $\sim 0.4\text{mm}^2$. The organic molecules investigated include mercaptohexadecanoic acid (MHA), hexadecanoic acid (HDA), and octadecyltrichlorosilane (OTS); all of which form ordered SAMs on top of aluminum oxide. The use of a superconducting electrode (Al) enables us to determine unambiguously that these are high-quality tunnel junctions. For junctions incorporating MHA, the transport behavior is found to be strongly humidity dependent. The resistance of these junctions drops more than 50% when placed in dry nitrogen and recovers when returned into the ambient. The same drop also occurs when the sample is placed into a vacuum, and backfilling the vacuum with either dry N2 or O2 has negligible effect on the resistance. For comparison, junctions with HDA show the same humidity dependence, while OTS samples do not. Since both MHA and HDA have carboxylic groups and OTS does not, the results suggest that water molecules at the AlOx/COOH- interface play the central role in the observed behavior. Inelastic tunneling spectroscopy (IETS) has also been performed to understand the role of water. This work was supported by a FSU Research Foundation PEG grant.

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