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Control of topography, stress and diffusion at molecule-metal interface NIKOLAI ZHITENEV, DONALD TENNANT, RAYMOND CIRELLI, Bell Labs., WEIRONG JIANG, ERIC GARFUNKEL, Rutgers, ARTUR ERBE, U. Konstanz, ZHENAN BAO, Stanford — The electronic properties of molecular devices that are just a few atomic layers thick are determined not solely by the properties of the molecules but are equally dependent on dopants, defects and electronic states at the interfaces. We study the phenomena affecting the conductance of molecular devices by systematically varying the growth conditions at the metal-molecule interface. Transport properties of metal-molecule-metal junctions containing monolayer of conjugated and saturated molecules with characteristic dimensions in the range of 30-300 nm are correlated with microscopic topography, stress and chemical bonding at metal-molecule interfaces. Small shadow masks defined within a stack of $Si/SiO_2/SiN_x/SiO_2$ layers are used to obtain features below the usual lithographic limits. We demonstrate that the defects/interfaces can be rationally controlled and that their properties are often more important than the electronic properties of molecules in determining the device conductance. The density of defects caused by metal penetration into monolayers is significantly reduced yielding >95% of non-shorted devices. Our statistically significant dataset allows us to conclude that the conductivity of organic molecules ∼1.5 nm long is at least 4 orders of magnitude lower than is commonly believed.

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