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Direct Patterning of Organic Self-Assembled Monolayer (SAM) on GaAs Surfaces via Dip-Pen Nanolithography (DPN) PENG XIONG, TIMOTHY KEIPER, Department of Physics, Florida State University, XIAOLEI WANG, JIANHUA ZHAO, Institute of Semiconductors, CAS — Hybrid structures of functional molecules and solid-state (SS) materials have attracted extensive interest in surface nanoscience and molecular electronics. The formation and micro/nano patterning of organic SAMs on SS surfaces are a key step in fabricating such devices. Here we report realization of high quality MHA SAMs on GaAs and direct formation of micro/nanoscale patterns of MHA SAM on the surface by micro-contact printing (μ CP) and DPN. The process begins with the preparation of an oxide-free surface of GaAs, for which we employed treatment by an ammonium polysulfide ($(NH_4)_2S_x$) solution. The treatment strips native oxides from GaAs creating an atomic layer of sulfur covalently bonded to the fresh surface. Formation of high-quality SAMs of thiol molecules on GaAs then proceeds through exchange of the sulfur and the thiol terminal of the molecules. The effects of the sulfur-passivation and formation of MHA SAM on the treated surface were confirmed by XPS, HRTEM, and DPN. To the best of our knowledge, this is a first realization of direct DPN of nanoscale organic SAM on a semiconductor free of surface oxide. We further evidence the utility of the hybrid platform by demonstrating directed self-assembly of Au nanoparticles onto MHA/ODT SAM templates on GaAs.

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