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Molecular Patterning and Directed Self-Assembly of Gold Nanoparticles on GaAs[1] TIANHAN LIU, TIMOTHY KEIPER, Florida State University, XIAOLEI WANG, Institute of Semiconductors, GUANG YANG, DANIEL HALLINAN, Florida State University, JIANHUA ZHAO, Institute of Semiconductors, PENG XIONG, Florida State University — The ability to organize Au NPs into ordered structures on solid-state substrates, especially semiconductors, holds great promise for controlled fabrication of nanoplasmonic devices. Here, we report on the development of a process for the formation and micro/nano patterning of self-assembled monolayer (SAM) of thiol molecules on GaAs, and the utilization of the molecular SAMs for the directed self-assembly of Au NPs. An ammonium polysulfide treatment of the GaAs substrate results in a sulfur-passivated oxide-free surface, which enables the formation of thiol molecule SAM via solution-based assembly. Furthermore, micro- and nano-scale patterns of thiol SAMs are created directly on the passivated GaAs surfaces by micro-contact printing and dip-pen nanolithography respectively. SAM patterns of different thiol molecules on GaAs are then used for Au NP assembly by leaving the substrate in the Au NP solution (13 nm 0.47 mM Au NPs in DI water) for 24 hours. 4-Aminothiophenol (ATP) SAM patterns result in highly specific Au NP assembly with clearly defined boundaries. The results are consistent with an assembly process driven by electrostatic interaction between the negatively charged Au NPs in an aqueous solution and positively charged ATP molecules on the GaAs substrate.

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