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Abstract

This report summarizes the research activities supported by the U.S. Department of Energy grant DE-SC-0010399. The goal of this project is to is to develop an on-demand nanoplasmonic platform that combines emerging oxide nanoelectronics with a low-loss semiconductor-friendly plasmonic materials. Toward this goal, several unique heterostructures formed between complex oxides and 2D layered materials have been developed. Based on these material systems, a set of atomic force microscope (AFM) based techniques have been developed that can allow long-living and reversible material phase transitions to be manipulated in nanoscale at room temperature. Using such technique and through interface coupling, we can effectively tune the plasmon propagations in unconventional plasmonic materials such as graphene and VO_2. In addition, we also discovered a plethora of novel interface enabled electro-optic effects, including the spatial modulation of light using 2DEG, a giant programmable photothermoelectric effects at room temperature, a light induced superconducting transition, and a tunable giant third order optical nonlinearities. These major results are outlined in this report, along with lists of project participants and products.