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Novel Sensor Design based on Switchable Electromagnetic-Induced Transparency CHRISTINA MCGAHAN, Department of Physics and Astronomy, Vanderbilt University, USA, KANNATASSEN APPAVOO, Interdisciplinary Materials Science Program, Vanderbilt University, USA, ETHAN PAUL SHAPERA, Department of Physics, University of Cambridge, UK, RICHARD F. HAGLUND JR., Department of Physics and Astronomy, Vanderbilt University, USA — We can increase detector sensitivity past that of conventional surface plasmon resonance (SPR) detectors by changing the local dielectric environment. Here we demonstrate a novel sensor design that combines SPR detection with a phase-changing element to increase detector sensitivity. Vanadium dioxide (VO_2) modulates the near-field dielectric environment of the electromagnetically induced transparency (EIT) nanostructures via its insulator-to-metal transition, which shifts the nanostructures' plasmonic response. We obtain a sensor design using three-dimensional, finite-difference time-domain (FDTD) simulations to optimize the dimensions of a gold pi nanostructure exhibiting EIT due to its dipole-quadrupole interaction. To verify our simulations, we use electron-beam lithography to fabricate arrays of optimal structures on VO_2 films deposited on ITO covered glass by pulsed laser deposition or electron-beam evaporation. We tune the EIT by varying the dimensions of the pi structures, thus changing the strength of the dipole-quadrupole interaction. The resonance of the structures of different separation distances is experimentally verified through measuring broadband white-light transmission while the VO_2 is thermally modulated.

Christina McGahan
Department of Physics and Astronomy, Vanderbilt University, USA

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