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Optical diffraction in ordered VO_2 nanoparticle arrays RENE LOPEZ, LEONARD FELDMAN, RICHARD HAGLUND, Deparment of Physics and Astronomy & Institute of Nanoscale Science and Engineering, Vanderbilt University, Nashville, TN, 37235 — The potential of oxide electronic materials as multifunctional building blocks is one of the driving concepts of the field. In this presentation, we show how nanostructured particle arrays with long-range order can be used to modulate an optical response through exploiting the metal-insulator transition of vanadium dioxide. Arrays of VO_2 nanoparticles with long-range order were fabricated by pulsed laser deposition in an arbitrary pattern defined by focused ion-beam lithography. The interaction of light with the nanoparticles is controlled by the nanoparticle size, spacing and geometrical arrangement and by switching between the metallic and semiconducting phases of VO_2. In addition to the near-infrared surface plasmon response observed in previous VO_2 studies, the VO_2 nanoparticle arrays exhibit size-dependent optical resonances in the visible region that likewise show an enhanced optical contrast between the semiconducting and metallic phases. The collective optical response as a function of temperature gives rise to an enhanced scattering state during the evolving phase transition, while the incoherent coupling between the nanoparticles produces an order-disorder-order transition.

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