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Switching Light through Arrays of Sub-wavelength Holes in Vanadium Dioxide[1] E. U. DONEV, J. Y. SUH, R. LOPEZ, R. F. HAGLUND, L. C. FELDMAN, Vanderbilt University, Nashville, Tennessee, USA — Transmission of near- and far-field light through periodic arrays of sub-wavelength holes is a subject of intense interest. We present the first studies on perforated vanadium dioxide (VO_2) thin films that can modulate the transmission of near-infrared light by virtue of their semiconductor-to-metal transition. Modulation arises because of the marked difference in dielectric contrast between the holes and the surrounding material in the two phases of VO_2. In perforated structures consisting of a silver (or gold) layer atop a VO_2 layer, the modulation effect constitutes a novel kind of dynamical control of the enhanced optical transmission through sub-wavelength holes in opaque metal films. Surprisingly, such double-layer structures exhibit a reversal in the optical switching of VO_2, as the near-infrared transmission during the metallic phase exceeds its semiconducting-phase counterpart—opposite of the transmission behavior of plain VO_2 films. We explain this by accounting for the loss of transmitted intensity due to leaky evanescent waves inside the holes and scattering at the entrance and exit apertures.

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