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Low-power laser induced metal-insulator transition in gold::vanadium dioxide nanoarrays DAVON W. FERRARA, EVAN R. MACQUARRIE, JOYEETA NAG, RICHARD F. HAGLUND, Department of Physics and Astronomy, Vanderbilt University — Vanadium dioxide (VO_2) is a strongly-correlated electron material with a well-known semiconductor-to-metal transition (SMT) that can be induced thermally, optically, or electrically. By coating lithographically prepared arrays of gold nanoparticles (NPs) of diameter 140 nm with a 60 nm thick film of VO_2 by pulsed laser deposition, hybrid Au::VO_2 structures were created. Due to the sensitivity of the Au particle-plasmon resonance (PPR), a temperature dependent shift in the PPR can be generated by switching the VO_2 from one phase to another, creating a tunable plasmonic metamaterial. To study the low-power switching characteristics of these structures, transient absorption measurements were made using a mechanically shuttered 785 nm pump laser, corresponding to the PPR resonance of the Au NPs, and 1550 nm CW probe. Results show that the presence of Au NPs significantly lowers the threshold laser power required to induce the SMT. Measurements on arrays of different grating constants (350 nm and 500 nm) support the hypothesis that the particles are acting as "nano-radiators" that absorb and redeposit thermal energy by scattering light back into the film. Finite element modeling was performed to better understand the complex thermodynamics of the structure.

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