Abstract Submitted
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Plasmonic electron injection drives ultrafast phase transition by catastrophic phonon collapse I: experiment[1] KANNATASSEN APPAVOO, Vanderbilt University, NATHANIEL F. BRADY, University of Alabama-Birmingham, BIN WANG, Vanderbilt University, MINAH SEO, Los Alamos National Lab, JOYEETA NAG, Vanderbilt University, ROHIT P. PRASANKUMAR, Los Alamos National Lab, SOKRATES T. PANTELIDES, Vanderbilt University, DAVID J. HILTON, University of Alabama-Birmingham, RICHARD F. HAGLUND, Vanderbilt University — Phase transitions in quantum materials such as vanadium dioxide (VO_2) can provide functionality in nanophotonic devices. Here we report on a novel all-optical mechanism to trigger phase transformation (PT) of VO_2 faster than its intrinsic single phonon period. By optically exciting a spectrally resonant sparse mesh of plasmonic gold nanoparticles, hot electrons created are ballistically injected across the Au/VO_2 interface to assist the sub-picosecond PT, lowering the switching threshold by a factor of five. As confirmed by density functional calculations, the injected electrons cause a catastrophic collapse of the 6 THz phonon mode in VO_2, essential for triggering its PT (next abstract). This demonstration of plasmon-induced hot-electron-driven PT controlled by this ultrafast technique represents a critical step towards developing hybrid nanomaterials with optimal switching thresholds.

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