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Characterization of TbAs nanoparticles embedded in GaAs using pump-probe measurements of carrier relaxation dynamics LAURA R. VANDERHOEF, University of Delaware, ABUL K. AZAD, DIBAKAR R. CHOWDHURY, Los Alamos National Laboratory, CORY BOMBERGER, JOSHUA M. O. ZIDE, MATTHEW F. DOTY, University of Delaware — Rare-earth-monopnictide nanoparticles epitaxially deposited within III-V semiconductors have been shown to improve the performance of devices for applications ranging from thermoelectrics to THz pulse generation. However, the electronic structure of small (approximately 1.5 nm diameter) TbAs nanoparticles remains poorly understood. We use ultrafast pump-probe spectroscopy to investigate the electronic structure of the TbAs nanoparticles. The samples studied were grown by co-deposition of Tb, Ga, and As on a GaAs substrate, resulting in TbAs nanoparticles embedded within a GaAs host. We study the dynamics of carrier relaxation into the TbAs states, which essentially act as traps, using both optical-pump terahertz-probe and optical-pump optical-probe techniques. By analyzing how the carrier relaxation rates depend on both pump fluence and sample temperature we conclude that the TbAs states are saturable, which suggests the existence of a bandgap for TbAs nanoparticles.

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