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Dynamics of ultra-fast laser excited carriers in semiconductor structures using second-harmonic generation

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We report recent experimental results on application of a novel pump-probe technique combining pump-probe reflection and pump-probe second harmonic generation (SHG), which can simultaneously be measured within the same experimental run. The technique is applied to monitor carrier (and spin) injection, transport across interfaces, and relaxation dynamics in multilayer semiconductor heterostructures. The pump-probe reflection signal monitors the population dynamics of free carriers in the conduction band while the SHG signal allows one to monitor the interfacial electrical fields created due to the space charge redistribution within the relaxation process. The laser light is tuned either below or above the band gap of GaAs in our GaAs/GaSb and GaAs/GaSb/InAs samples. The dynamics of carriers and interfacial fields as a function of temperature, wavelength, pump power, and azimuthal angle is discussed. By using lasers to pump energy into our systems, we can monitor the pathways that this energy is dissipated during relaxation processes. This is necessary to understand the physics leading to ablation.

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