Nonequilibrium electron-phonon dynamics in ruthenium thin films exposed to ultra-short laser pulses.

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Abstract

The application of high repetition rate Free Electron Laser sources requires the development of robust optical coatings that will survive after being exposed to ultra-short, high peak intensity laser pulses. As a mirror for the case of grazing incidence reflectance, metal thin films are widely used. To study the lifetime of such optical coatings, the interaction of ultra-short laser pulses with metals must be understood. Since the pulse duration is comparable to or shorter than the thermalization time of the system, one needs to consider nonequilibrium electron-phonon dynamics that takes place after the laser pulse heats electrons at the surface.

The two-temperature model, with electron-phonon coupling, was used to calculate surface temperature changes of ruthenium thin films due to ultrafast laser heating. Time-domain thermoreflectance measurements were performed with 300 fs visible pump and probe pulses to monitor the surface reflectivity change.