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The dielectric response of single-crystal UO_2 probed by terahertz time-domain spectroscopy YONG AN, MST-8, Los Alamos National Laboratory, Los Alamos, NM 87545, USA, TREVOR TYSON, Department of Physics, New Jersey Institute of Technology, Newark, NJ 07102, USA, STEVEN CONRADSON, MST-8, Los Alamos National Laboratory, Los Alamos, NM 87545, USA — We measured the complex dielectric function, $\varepsilon = \varepsilon_r + i\varepsilon_i$, of single-crystal UO_2 in the temperature (T) range of 5-500 K by terahertz (THz) time-domain spectroscopy to study its dielectric response. A critical temperature point of 60 K is found for the measured temperature dependence of $\varepsilon_r(T)$. The dispersion of $\varepsilon(\omega)$ in the THz range follows the trend of the damped resonant mode of the transverse optical phonon at ω_{TO}=8.4 THz. Examining the Lyddane-Sachs-Teller relationship reveals mode-softening of ω_{TO} in the temperature range of 60-120 K. We then performed optical-pump THz-probe measurements to study the dynamic dielectric response of UO_2 following photoexcitation. We observe a small pump-induced change in ε that lasts for more than one millisecond, indicating heavy electron behavior of photoexcited 5f electrons resulting from strong electron-lattice interaction. The slow relaxation is attributed to the diffusion of optical phonons generated by photoexcited 5f electrons in the UO_2 crystal.

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