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Observation of internal excitation transfer in luminescent lanthanide materials by time-resolved X-ray absorption spectroscopy[1]
JOSEPH PACOLD, Univ of Washington, DAVID TATUM, Univ of California, Berkeley, GERALD SEIDLER, Univ of Washington, KENNETH RAYMOND, Univ of California, Berkeley — Luminescent lanthanide materials have a broad range of established and emerging applications, including fluorescent lighting and displays, laser materials, dyes for biomedical assays, and wavelength-converting coatings for solar cells. Most of these applications make use of parity-forbidden transitions with the partially filled 4f shells of the trivalent lanthanide ions, which lead to emission lines at wavelengths spanning the visible spectrum. The desired excited state of the lanthanide ion is typically populated by energy transfer (ET) from a strongly absorbing "sensitizer," rather than by direct excitation. We have observed a transient X-ray absorption spectroscopy signal associated with the ET in several luminescent dyes and a suspension of an inorganic Eu phosphor. This opens up a novel approach to studies of internal ET in luminescent materials, complementary to previous measurements at optical wavelengths. In addition, the transient signal shows an unexpected change in 5d electronic structure accompanying the 4f-4f transition, which suggests that the intrashell excitation is associated with a change in the degree of mixing of 4f-5d states.

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