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Energies of $4f^N$ and $4f^{N-1}5d$ States Relative to Host Bands in Rare-earth-doped Fluorides[1] C.W. THIEL, A. COLLOMBET, R.L. CONE, Montana State University, M.-F. JOUBERT, LPCML, Universite Claude Bernard de Lyon, A. TKACHUK, All-Russia Research Center, Vavilov State Optical Institute — Energies of $4f^N$ states relative to crystal band states were measured for rare-earth ions in the optical host materials $LiYF_4$, $Na_{0.4}Y_{0.6}F_{2.2}$, and LaF_3 using x-ray photoemission spectroscopy. Spectra were modeled to determine the valence band maximum and 4felectron binding energies in each material. These results were combined with $4f^N$ to $4f^{N-1}5d$ transition energies to determine 5d binding energies for the lowest levels of excited $4f^{N-1}5d$ configurations. While $4f^N$ ground-state energies vary within several eV of the valence band maximum for different rare-earth ions in each host, the lowest $4f^{N-1}5d$ states have similar energies and are several eV below the bottom of the conduction band. A simple model accurately described $4f^N$ and $4f^{N-1}5d$ binding energies across the entire series of rare-earth ions. These results improve the understanding of optical materials for lasers, phosphors, and spectral hole burning applications for optical signal processing and data storage.

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Charles Thiel
Montana State University

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