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Modeling NIR-to-Visible Upconversion Kinetics in Er^{3+}, Yb^{3+}:$NaYF_4$ Nanocrystals and Finite-difference Time-domain Simulations of Noble-metal Enhancement Substrates ROBERT ANDERSON, South Dakota School of Mines and Technology, GE YAO, QUOCANH LUU, University of South Dakota, HARI PAUDEL, KHADIJEH BAYAT, MAHDI BAROUGHI, South Dakota State University, CUIKUN LIN, MARY BERRY, STANLEY MAY, University of South Dakota, STEVE SMITH, South Dakota School of Mines and Technology — Upconversion (UC) phosphors are able convert infra-red light to visible wavelengths. The (erbium) Er^{3+}, (ytterbium) Yb^{3+}: $NaYF_4$ system is the most efficient upconversion phosphor known, and yet the quantitative aspects of the mechanism responsible for upconversion, such as the values of key microscopic rate constants, have not been determined. In this work, the dynamics of the photo-physical processes leading to near-infrared (NIR) to visible upconversion in Er^{3+}, Yb^{3+}: $NaYF_4$ nanocrystals are investigated using a nonlinear rate-equation model. In tandem with this effort, we use finite difference time domain (FDTD) simulations to analyze noble-metal nanostructures designed to enhance the absorption and emission of the upconverting phosphor. Simulation results are compared with time-resolved luminescence and reflectivity of the plasmonic substrates, which show systematic improvement in fluorescence yield and good agreement with simulated kinetics.

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