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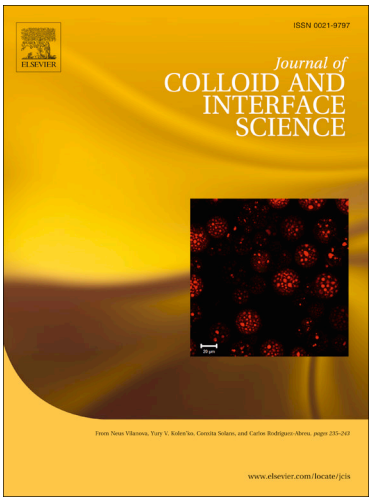


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# Ultrafast synthesis of bifunctional $Er^{3+}/Yb^{3+}$-codoped $NaBiF_4$ upconverting nanoparticles for nanothermometer and optical heater

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## Abstract

We reported a simple and ultrafast route to synthesize the bifunctional $Er^{3+}/Yb^{3+}$-codoped $NaBiF_4$ upconverting nanoparticles. It was found that the phase compositions and microstructure of the prepared samples were strongly dependent on the $NH_4F$ content. When the $NH_4F$ content was 14 mmol, after 1 min reaction at room temperature, the resultant compounds exhibited pure single phase and were composed of uniform spherical nanoparticles. Under 980 nm light irradiation, the synthesized nanoparticles emitted visible emissions originating from the intra-4f transitions of $Er^{3+}$ ions and the involved upconversion luminescence mechanism was associated with the typical two-photon process. With the aid of the fluorescence intensity ratio technique, the optical thermometric behaviors of the studied nanoparticle based on the ($^2H_{11/2}$,$^4S_{3/2}$) thermally-coupled levels in the temperature range of 303-483 K were systematically analyzed and the maximum sensor sensitivity was determined to be about 0.0057 $K^{-1}$ at 483 K. Furthermore, the internal heating properties of the resultant nanoparticles induced by the laser power source were also studied. With elevating the pump power from 159 to 658 mW, the