Electronic Supplementary Material (ESI) for Nanoscale.
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SUPPORTING INFORMATION

Reliability of rare-earth-doped infrared luminescent nanothermometers

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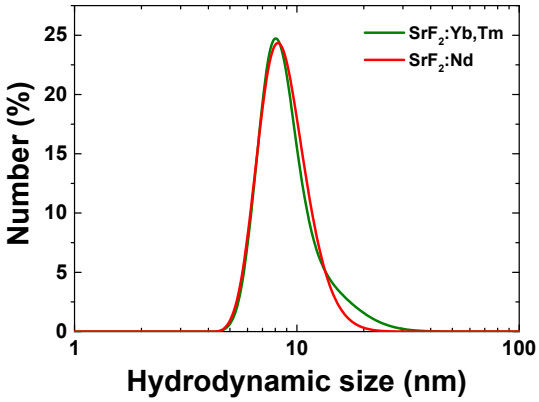

Figure S1. Dynamic light scattering measurement of the hydrodynamic size of SrF_2:0.5Nd (red) and SrF_2:0.218Yb,0.002Tm (green).

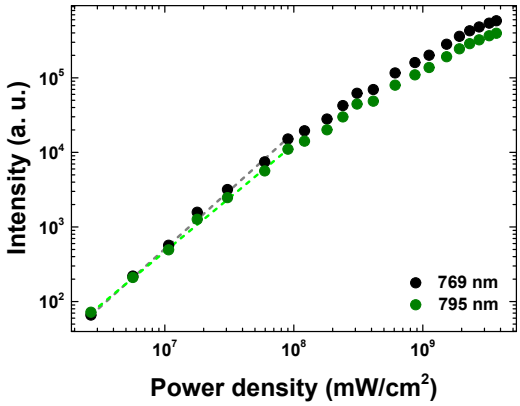

Figure S2. Emission intensity of both transitions in the emission band of Tm^{3+} ions at about 780 nm as a function of excitation power desnity. Dashed lines are a fit to show the different slopes.

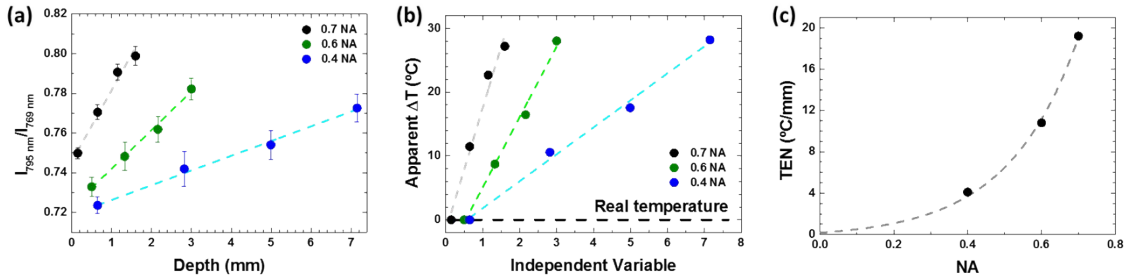

Figure S3. Dependence of the spectral change with the NA. (a) Ratio of the two emissions in the emission band of Tm^{3+} RE-LNThs at around 780 nm at a fixed applied excitation power density as a function of the depth of the excitation/collection focus for different objective lens numerical apertures. Dashed lines are guides to the eye. (b) TEN (dots), i.e. apparent increment of temperature, from the spectral shift with the change of depth due to the excitation power dependence of the emission band shape for different NA. The black dashed line indicates the real temperature. Colored dashed lines are guides to the eye. (c) Dependence of the TEN with the NA. The dashed line is a guide to the eye.

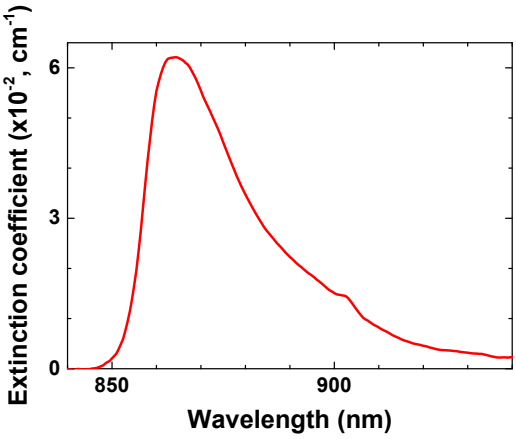

Figure S4. Absorption spectra of SrF_2:0.5Nd LNThs.

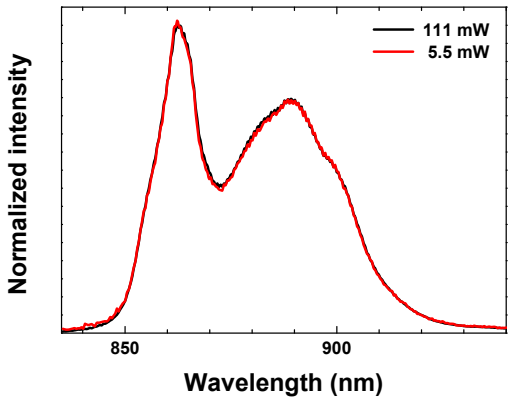

Figure S5. Emission spectra of SrF_2:0.5Nd LNThs at around 880 nm under excitation at different excitation powers at 808 nm.

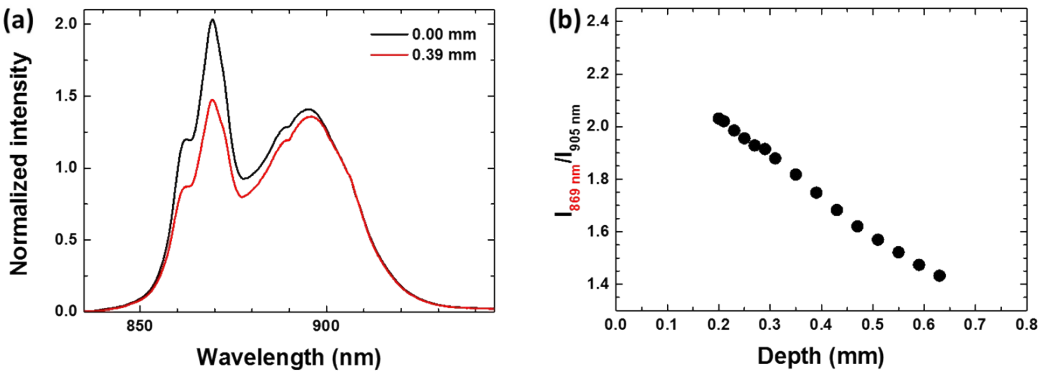

Figure S6. (a) Emission spectra of SrF_2:0.5Nd RE-LNThs with the excitation/collection focus at different depths in the dry set of RE-LNThs. (b) Intensity ratio of this emission at different depths. Note that the scale is different than those of Figure 3d and S7b.

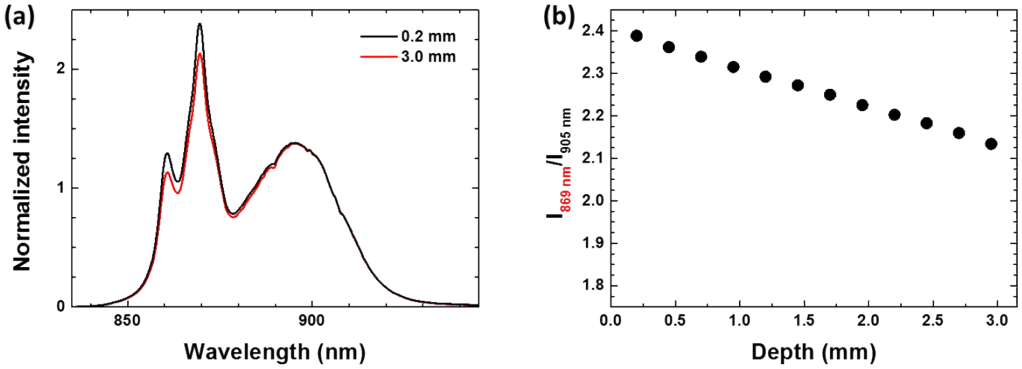

Figure S7. (a) Emission spectra of SrF_2:0.22Nd RE-LNThs with the excitation/collection focus at different depths in the colloidal dispersion of RE-LNThs. (b) Intensity ratio of this emission at different depths. The dashed line is the fit to the behavior expected by Lambert-Beer equation (Equation (1)).

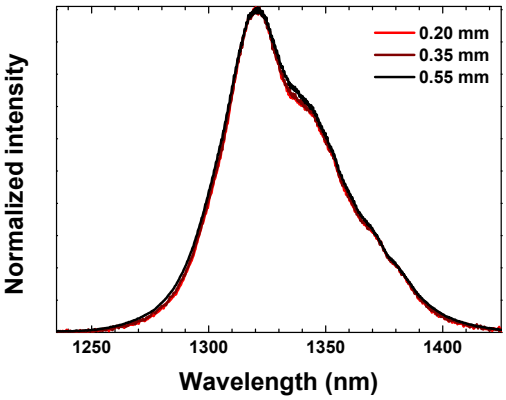

Figure S8. Emission spectra of SrF_2:0.5Nd RE-LNThs at around 1320 nm under excitation at 808 nm at different excitation/collection focus depths in a dry set of RE-LNThs.

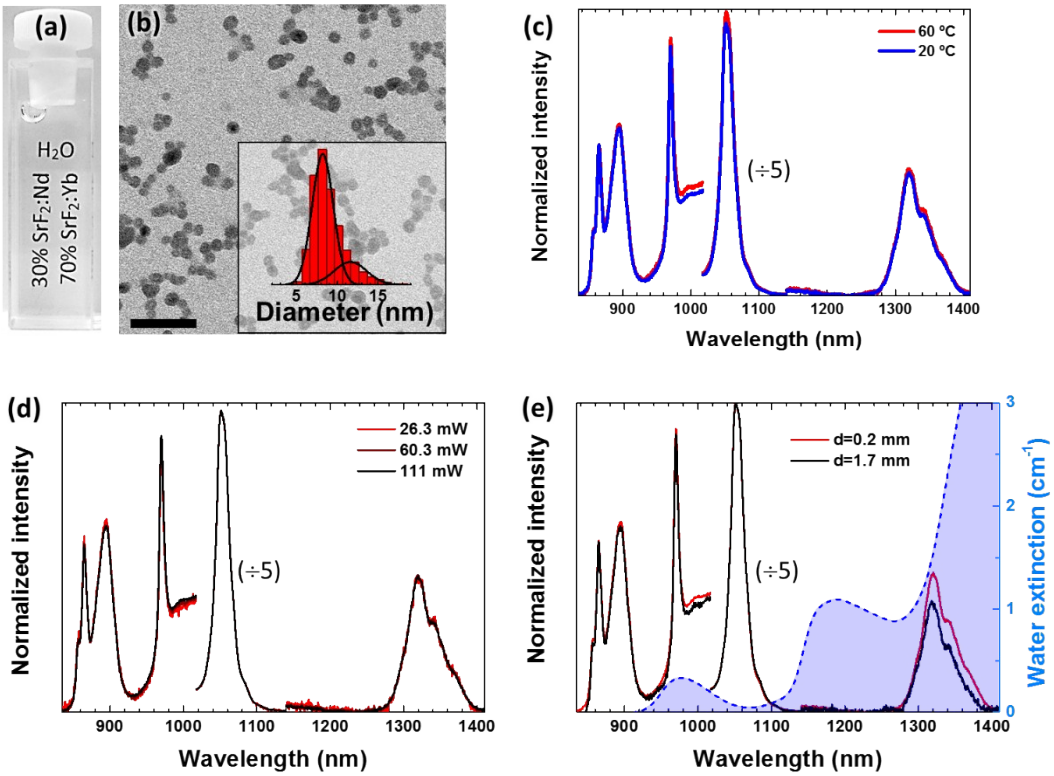

Figure S9. (a) Optical image of colloidal dispersion, (b) transmission electron microscopy images (scale bar: 50 nm; inset: size distribution obtained from diverse images), emission spectra (c) at different temperatures, (d) at different excitation powers, and (e) at different depths of the excitation/collection focus at in the colloidal dispersion of RE-LNThs for SrF_2:Nd+SrF_2:Yb RE-LNThs after interparticle ion exchange in H_2O.