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Evaluating $NaNdF_4:x\%Yb^{3+}$ (x = 5, 7, 10, 20) nanoheating properties by $NaYF_4:Yb^{3+}$, Er^{3+} luminescent thermometer: The impact of shell type

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In this study, we investigated the heating properties of $NaNdF_4$ nanoparticles (NPs) co-doped with Yb^{3+} ions ($NaNdF_4:x\%Yb^{3+}$, x = 5, 7, 10, 20), focusing on the impact of different surface coatings; silica (SiO_2), polyethylene glycol (PEG), and cetyltrimethylammonium bromide micelles (CTAB) on their photothermal conversion efficiency. Luminescent $NaYF_4:18\%Yb^{3+},2\%Er^{3+}$ NPs were employed as thermometric sensors, enabling the quantitative determination of heat generation by monitoring the luminescence intensity ratio of thermally coupled up-conversion emission bands. The study demonstrates that both the surface coating and Yb^{3+} ion concentration significantly influence the rate and magnitude of the temperature increase. The highest temperature rise (ΔT = 10.0°C) was observed for $NaNdF_4:7\%Yb^{3+}$ NPs coated with SiO_2, attributed to effective core isolation and high thermal conductivity of the SiO_2 layer. Lower ΔT values were recorded for NPs coated with PEG (7.9°C) and CTAB (5.9°C), reflecting reduced environmental isolation and less efficient energy transfer between ions. Additionally, we found that the coating type strongly affects the kinetics of temperature increase, which is crucial for potential applications in photothermal therapy and biomedical nanotechnology. These findings highlight the importance of precise control over nanoparticle surface structures to optimize their functional properties for applications in luminescent thermometry and nanomedicine.

Słowa kluczowe

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