

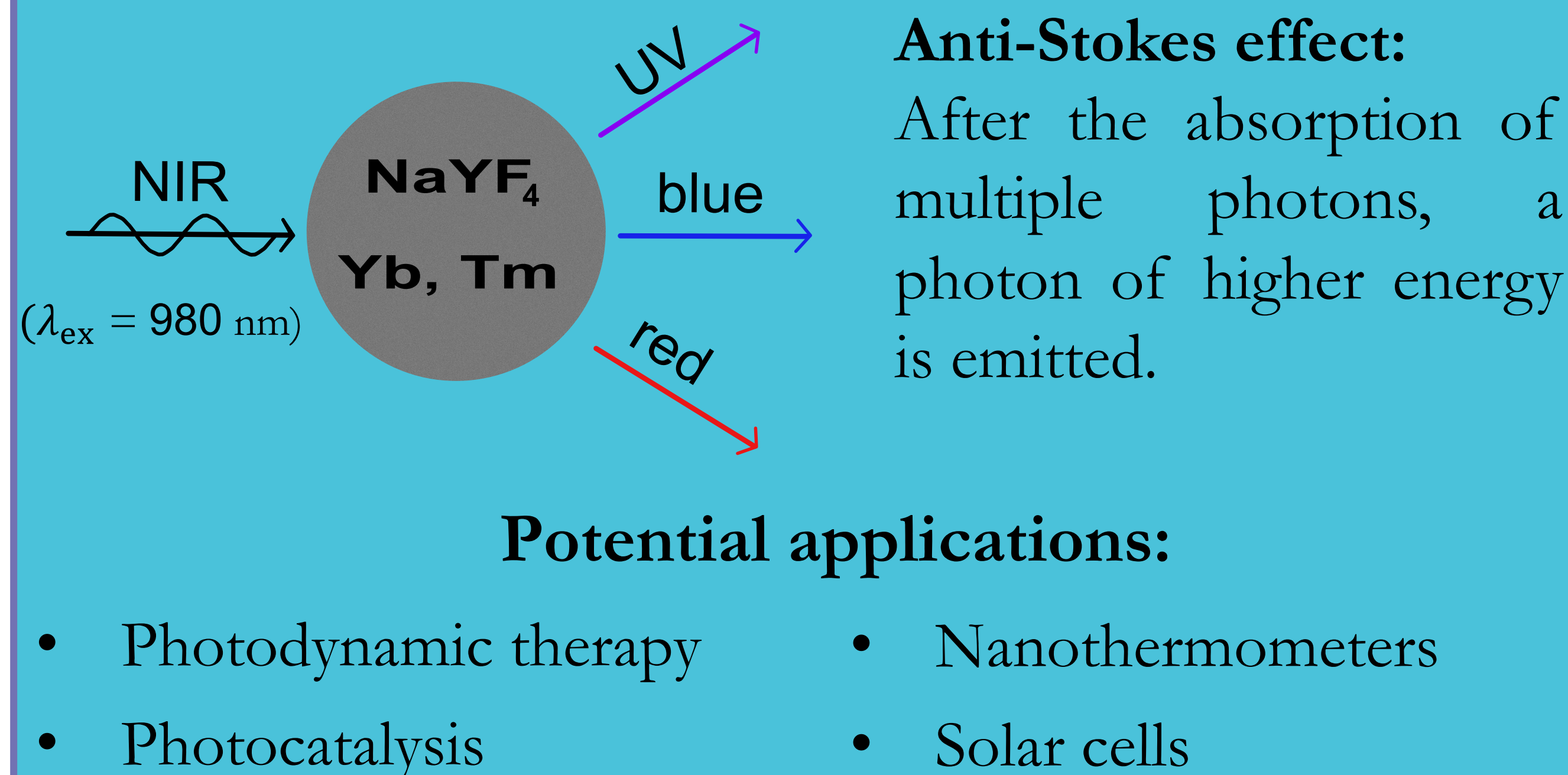
Upconverting Nanoparticles: Energy Transfer with Dye Molecules in Suspensions and Thin Film Systems

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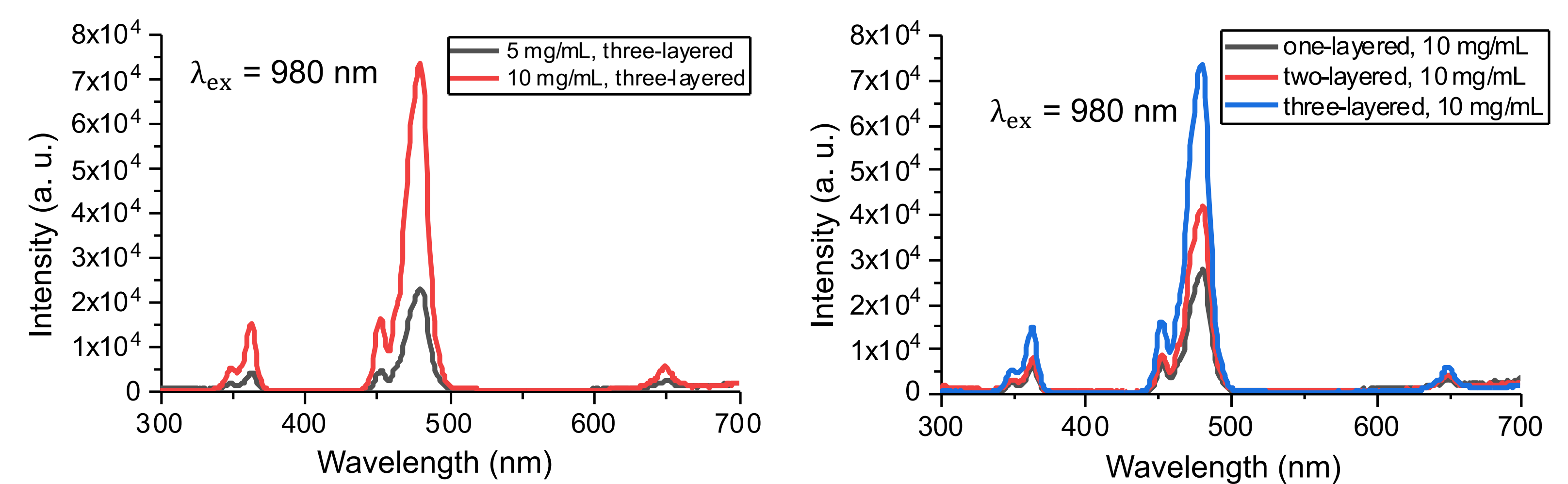


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Introduction

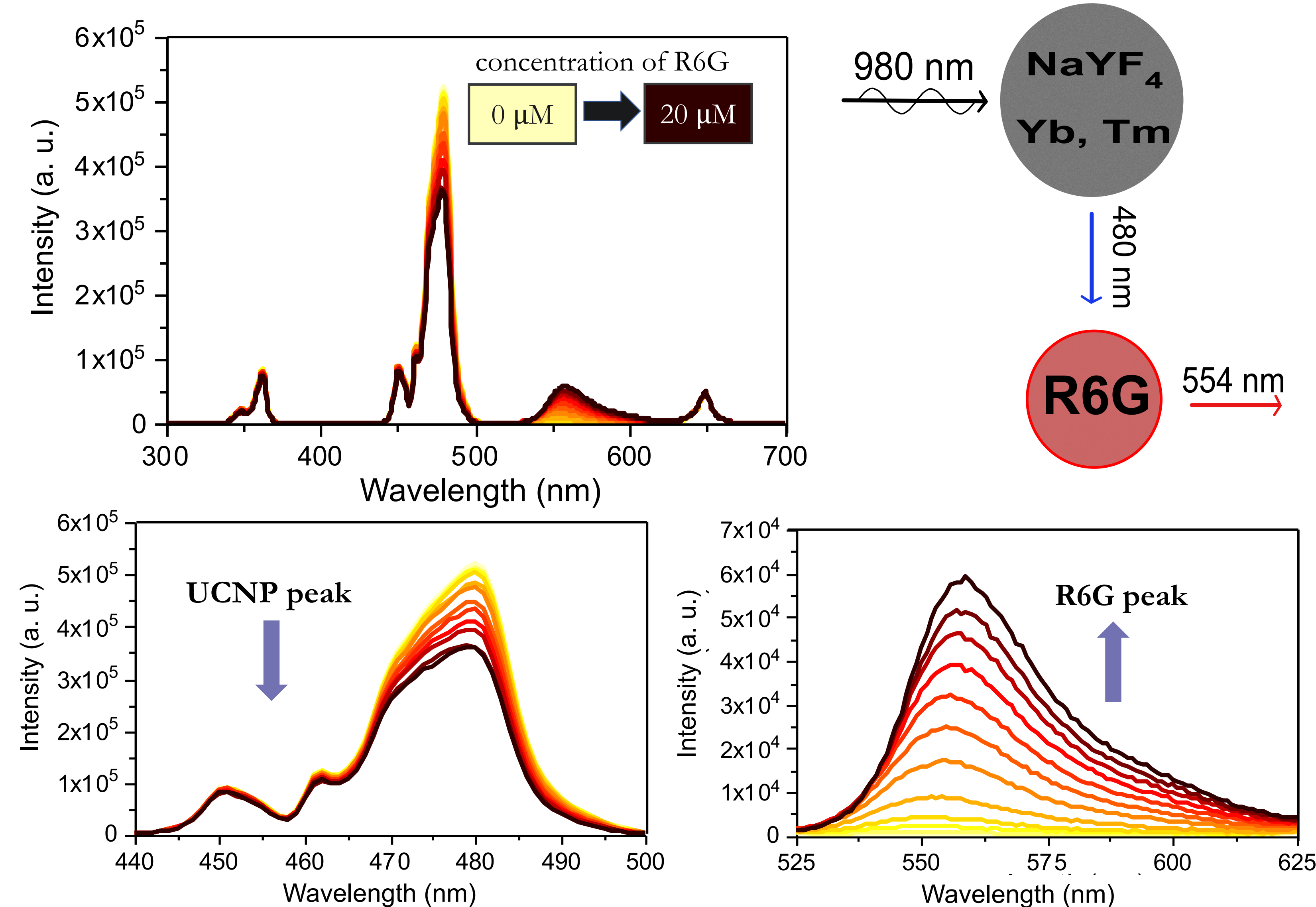


1 Emission spectrum of chitosan-matrix composite UCNP-coatings

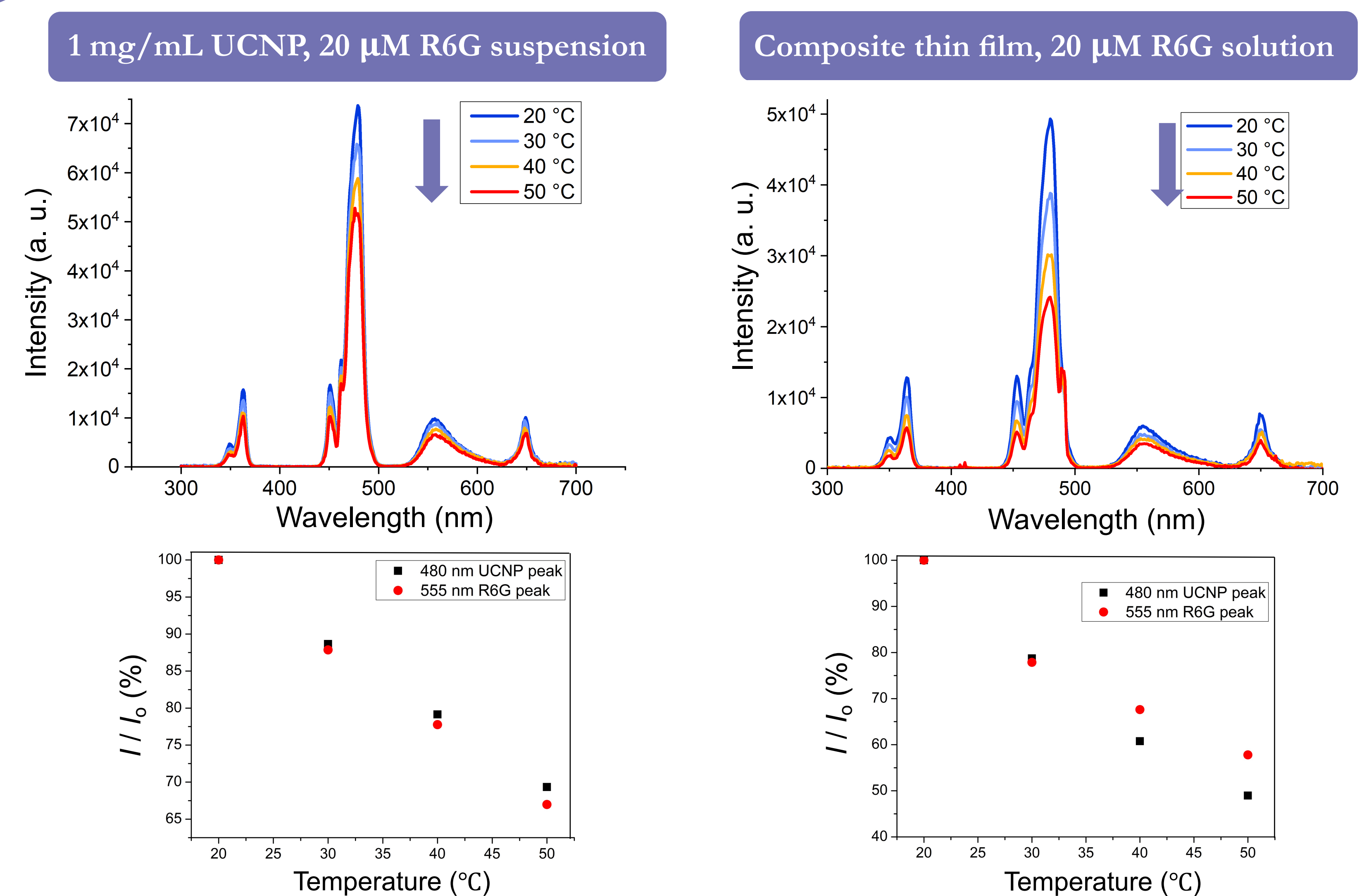


↑ amount of UCNPs ⇒ ↑ emission intensity ⇐ ↑ layer thickness

2 Energy transfer between UCNPs and R6G in aqueous suspension under NIR excitation



3 Thermosensitivity of R6G containing UCNP suspensions and thin films



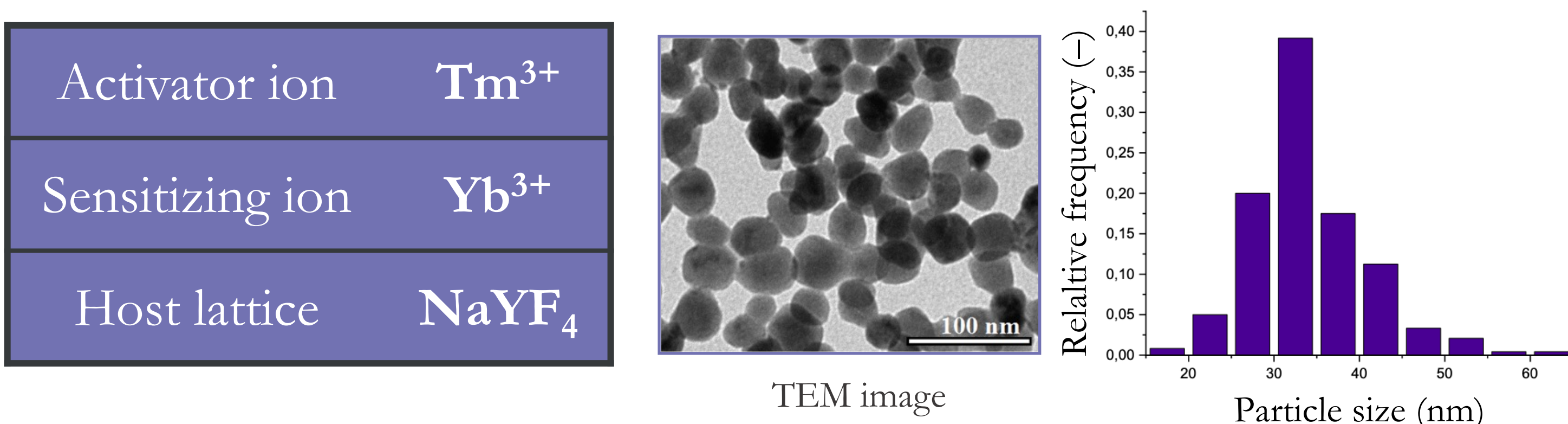
Conclusions

- Colloidal **NaYF₄:Yb,Tm** particles with **intensive anti-Stokes emissions** were synthesised.
- Using UCNP containing **chitosan-matrix thin films**, high emission intensities were obtained under NIR excitation.
- Förster resonant energy transfer** (FRET) was observed between UCNPs and R6G fluorescent dye molecules.
- Thermosensitivity** of UCNPs was studied, the **emission intensities decreased** as the temperature was increased. This effect was greater in composite coatings.
- Future aims** include studying energy transfer processes in UCNP/semiconductor oxide photocatalytic systems.

Aims

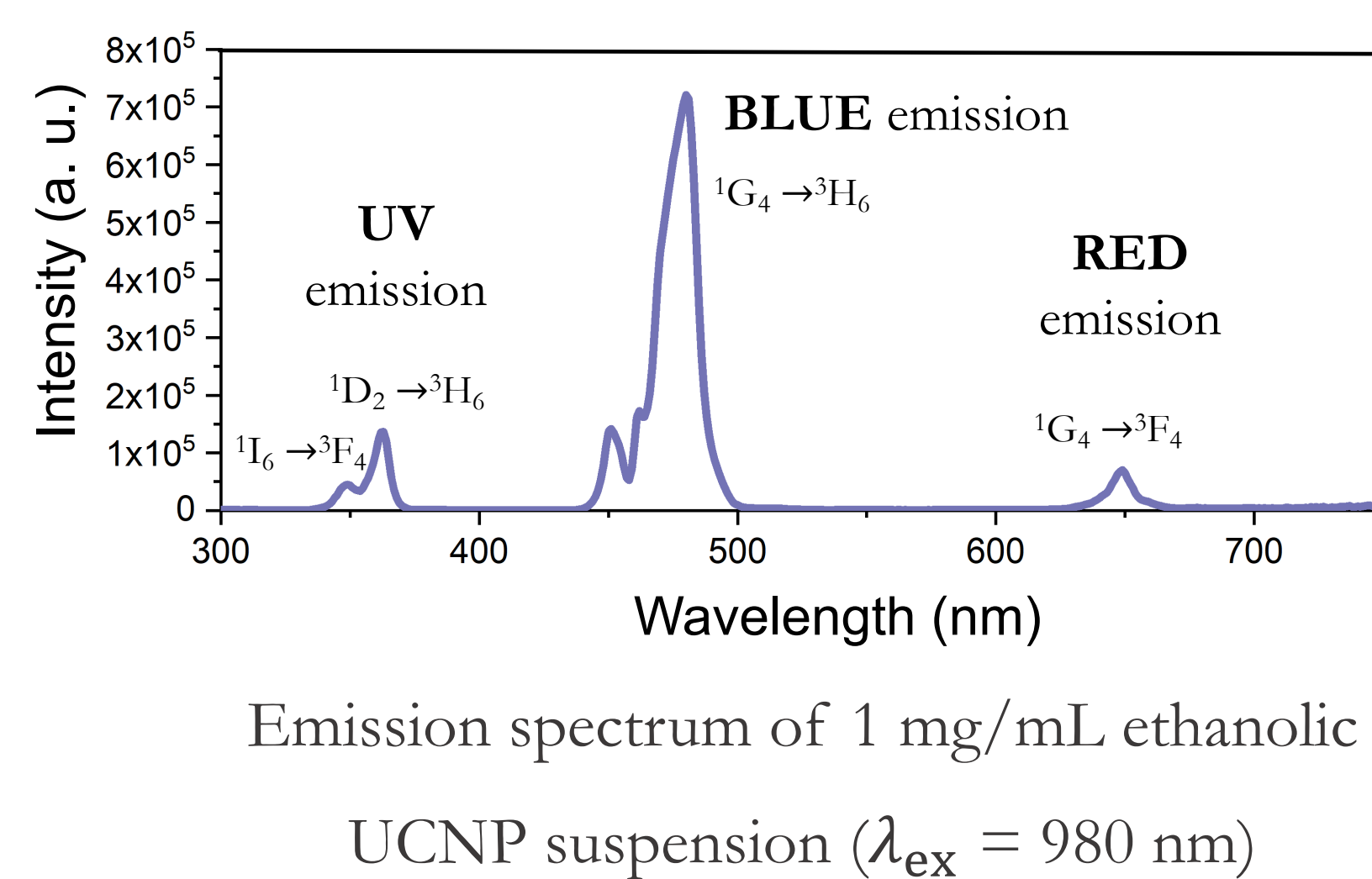
- Synthesis** and characterization of NaYF₄:Yb³⁺, Tm³⁺ upconverting nanoparticles (UCNP) and their **composite coatings**.
- Studying **energy transfer processes between UCNPs and Rhodamine-6G (R6G) dye molecules** under NIR radiation.
- Determining the **temperature sensitivity** of upconversion and energy transfer phenomena.

UCNP synthesis: α-NaYF₄:20% Yb³⁺, 0,5% Tm³⁺



Solvothermal method:

ethylene glycol solvent
NaF, LnCl₃ · 6 H₂O (Ln=Y, Yb, Tm)
PVP (M = 40 000 g/mol)



Preparation of thin films:

Chitosan-matrix UCNP-containing film	Spin-coating method 50 μL droplet, 7000 rpm, 60 s
mesoporous titania	Dip-coating method $d = (154 \pm 5) \text{ nm}$, $\varepsilon = (52 \pm 1) \%$
compact silica	Dip-coating method $d = (202 \pm 5) \text{ nm}$
glass substrate	