

Eosin Y Interaction with Ni-Fe LDH nanoparticles

E. Bereznyak¹, E. Dukhopelnikov¹, A. Laguta², N. Gladkovskaya¹, C. Neves³

Research Aim

To investigate the interaction between Ni₂FeOH layered double hydroxide (Ni-Fe LDH) and the dye eosin Y (Eos) in aqueous suspensions

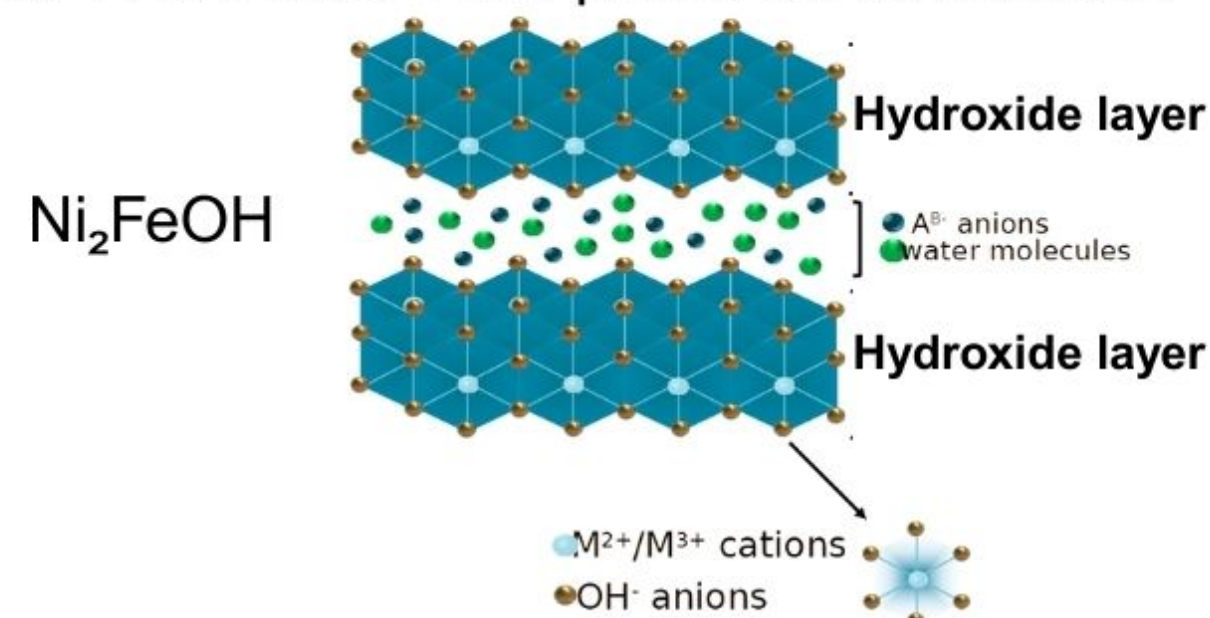
Objectives

- To elucidate the type of Eos interaction with Ni-Fe LDH
- To calculate the Eos loading parameters to Ni-Fe LDH
- To determine the influence of Eos on the hydrodynamic properties of Ni-Fe LDH nanoparticles

Experimental Techniques

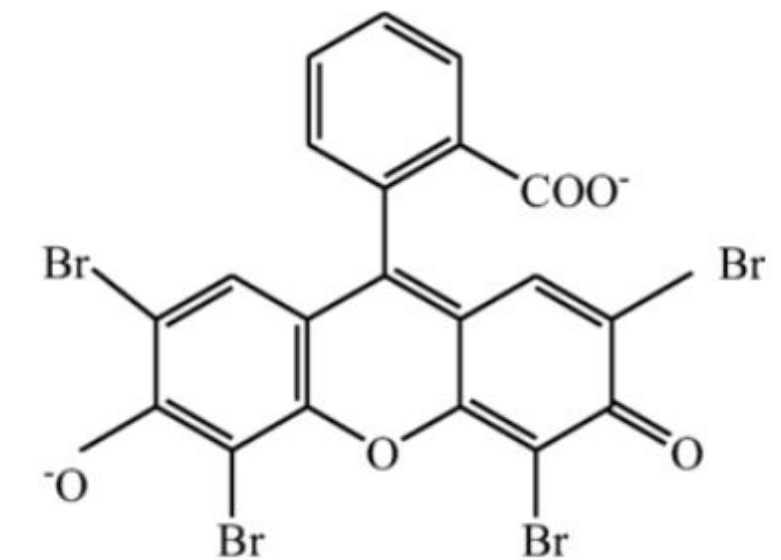
Dynamic and electrophoretic light scattering
UV-VIS spectroscopy
X-ray diffraction

Ni-Fe LDH samples were synthesized via coprecipitation under a nitrogen atmosphere. Aqueous suspensions of Ni-Fe LDH were prepared by ultrasonic treatment at 44 kHz and 1 kW power for 30 minutes



Reagents

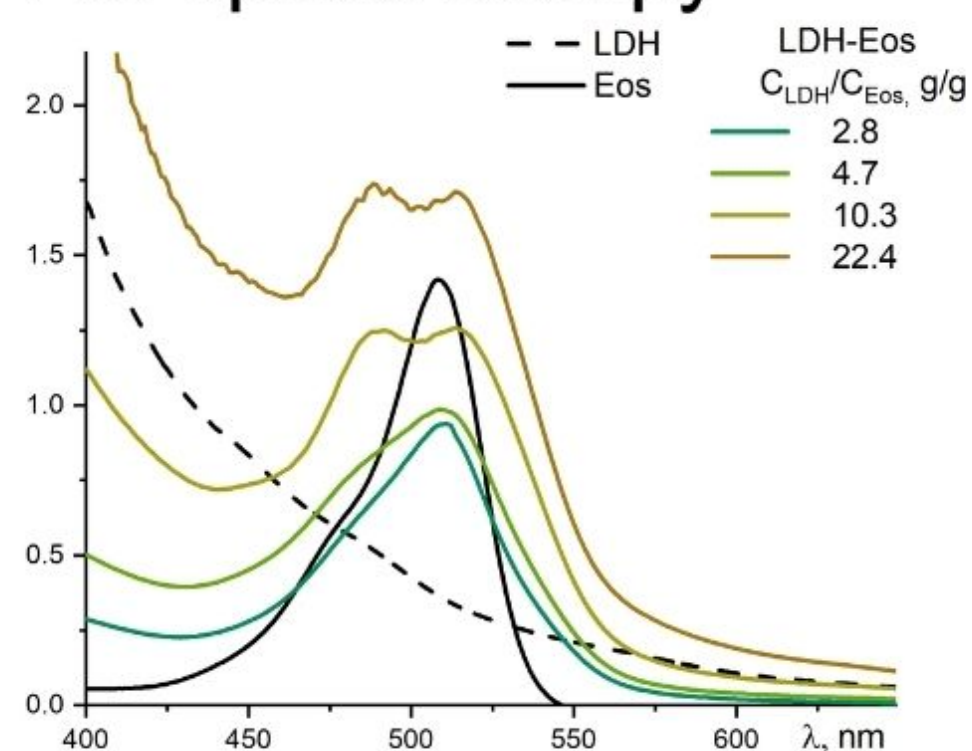
Eosin Y (Eos), Reachim
2,4,5,7- tetrabromofluorescein disodium salt, pK₂ =3.8



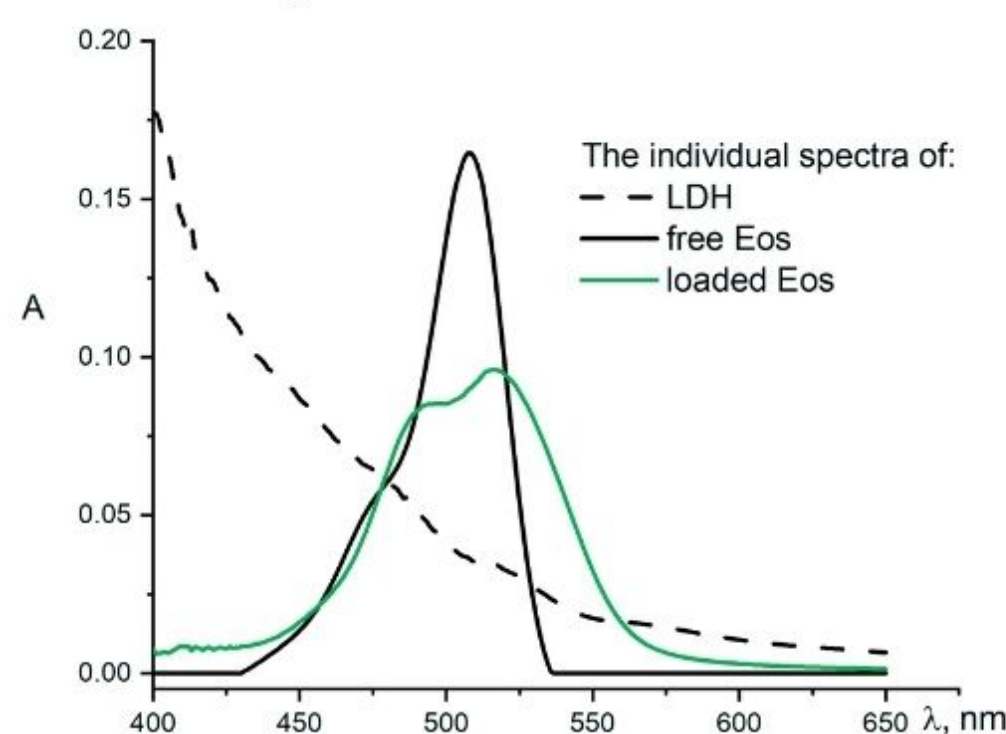
Eosin Y double-charged form

Results

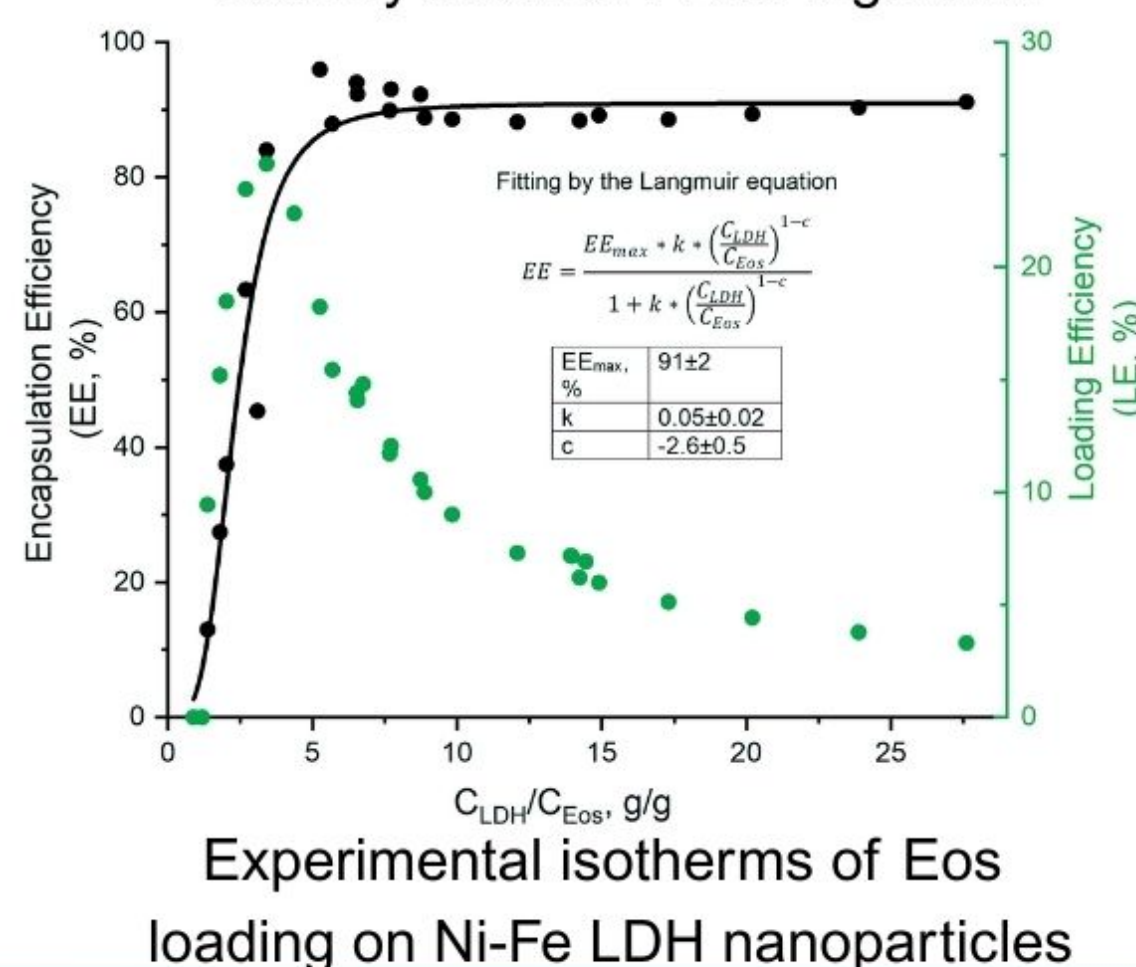
UV-VIS spectroscopy



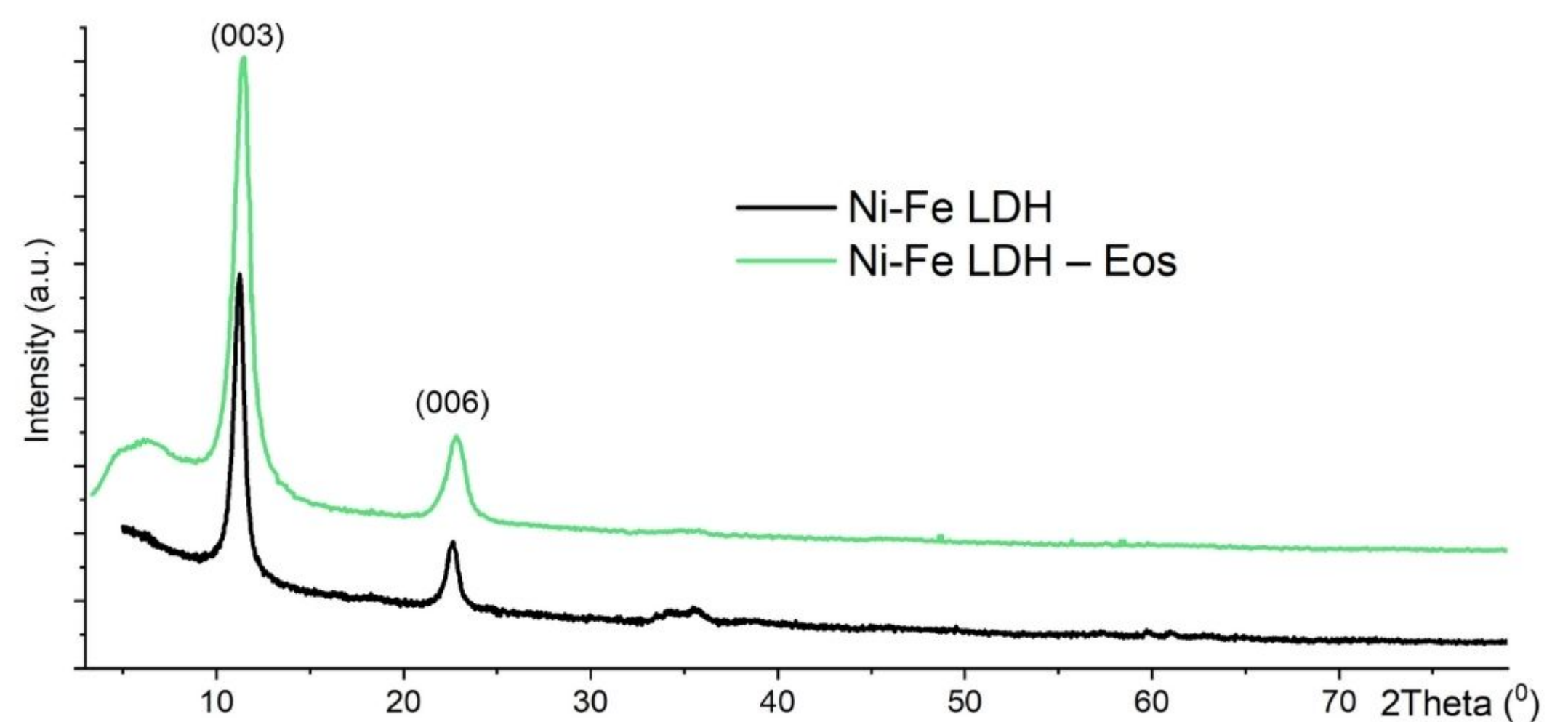
The titration experiment in Ni-Fe LDH - Eos system
 $C_{\text{Eos}} = 1.07 \cdot 10^{-2} \text{ g L}^{-1}$ $C_{\text{LDH}} = 0 \div 0.33 \text{ g L}^{-1}$



The decomposition of the Ni-Fe LDH - Eos titration data by the MCR-ALS algorithm

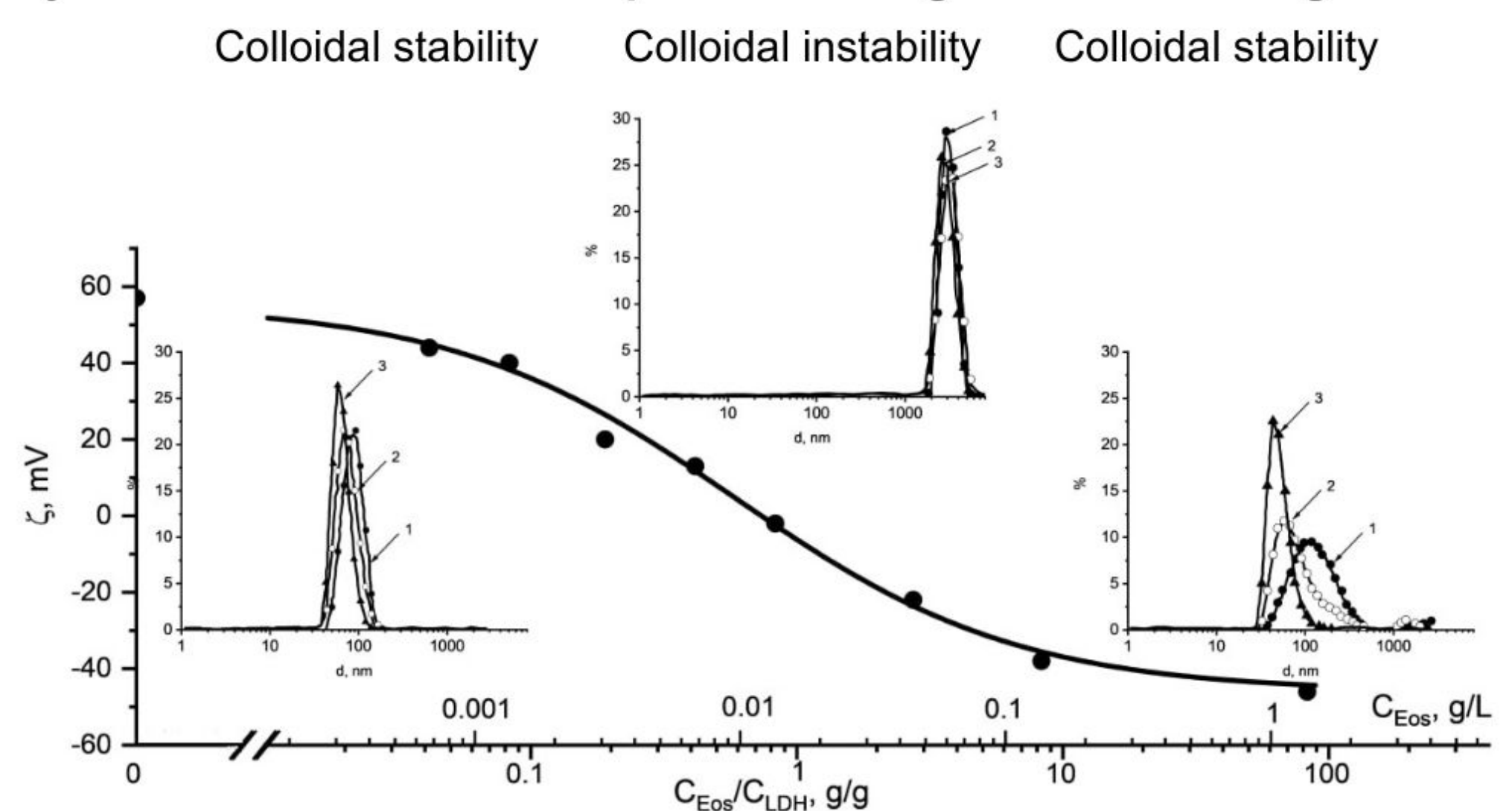


X-ray diffraction



XRD patterns of Ni-Fe LDH and the dried precipitate from the Ni-Fe LDH - Eos suspension with $C_{\text{Eos}}/C_{\text{LDH}} = 25 \text{ g/g}$. Positions of the most intensive reflections of Ni-Fe LDH are marked (indexed in an hexagonal lattice)

Dynamic and electrophoretic light scattering



Dependence of Ni-Fe LDH zeta potential (ζ) on relative Eos concentration ($C_{\text{LDH}} = 0.02 \text{ g L}^{-1}$)
Size distribution (d) of Ni-Fe LDH nanoparticles with adsorbed Eos:
by intensity (1), by volume (2), and by particle number (3)

Conclusions

- Eosin Y loads on Ni₂FeOH nanoparticles predominantly through surface adsorption.
- Due to the high positive surface charge (zeta potential is about 50 mV), Ni₂FeOH LDH exhibits strong sorption capacity toward eosin Y, as indicated by high encapsulation efficiency ($EE_{\text{max}} = 91\%$) and loading efficiency ($LE_{\text{max}} = 25\%$).
- Eosin Y adsorption on Ni₂FeOH reduces the nanoparticles' zeta potential and the colloidal stability of the suspensions. At high eosin Y concentrations, surface charge reversal (down to -45 mV) occurs, restoring colloidal stability.