

Abstract

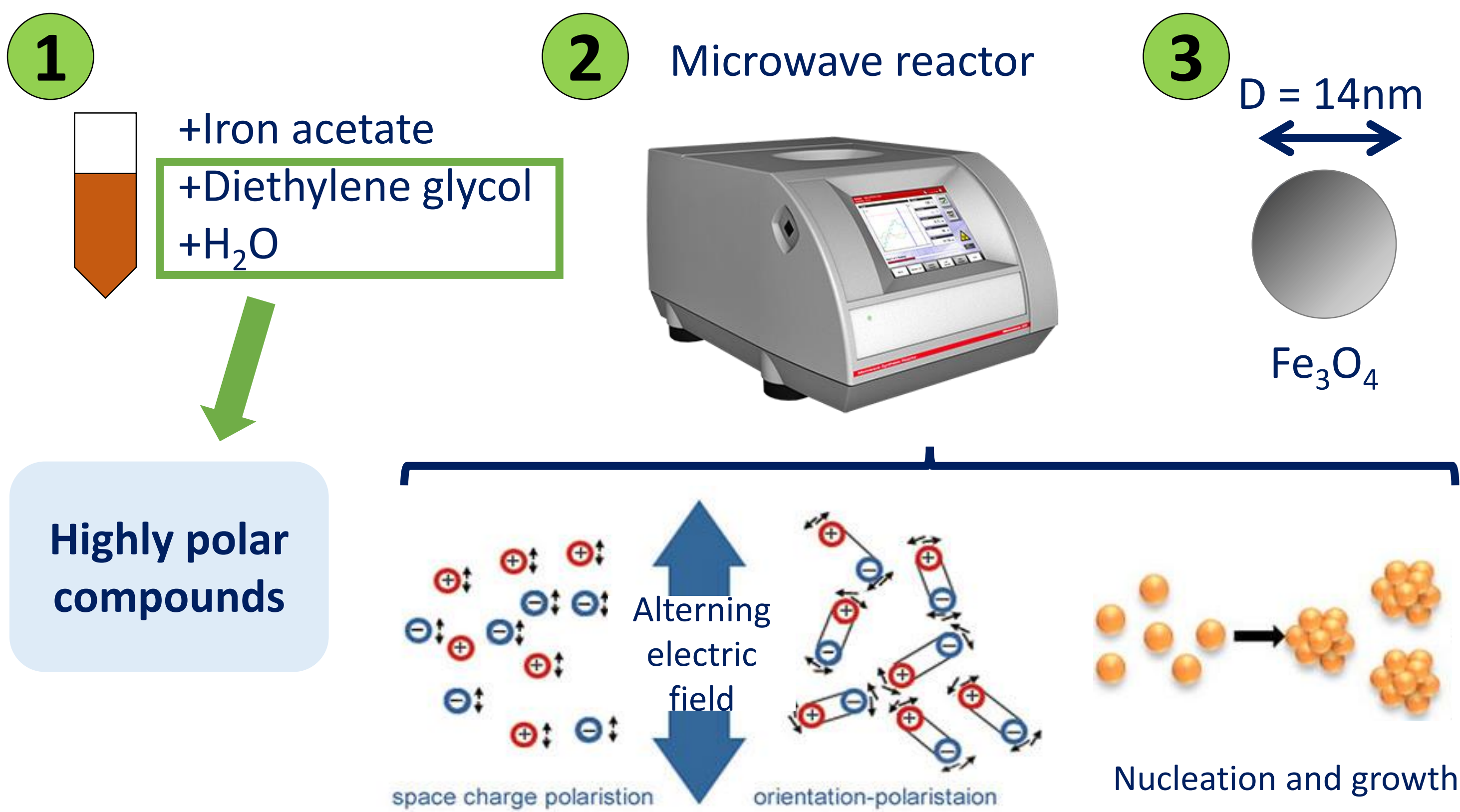
In order to understand the influence of the surface charge in the adsorption mechanism of iron oxide magnetic nanoparticles, the removal of chromium from aqueous solution was investigated in a batch experimental setup. Synthesis of the 14 nm width magnetic nanoparticles (Fe_3O_4) was performed via a microwave reactor and then, the surface charge was varied by grafting with tetraethyl orthosilicate (TEOS) and (3-aminopropyl)triethoxysilane (APTES). Different experimental approaches were applied to show mechanistic aspects, such as adsorption isotherms and kinetics studies. Adsorption equilibrium studies showed that Fe_3O_4 @TEOS barely remove the chromium from de media, while chromium adsorption with Fe_3O_4 and Fe_3O_4 @TEOS@APTES, followed the Langmuir model with a maximum adsorption capacity of 15 and 30 mg of Cr/g of NPs, respectively. The kinetics of the interactions was best described by pseudo-second-order mechanism.

Introduction

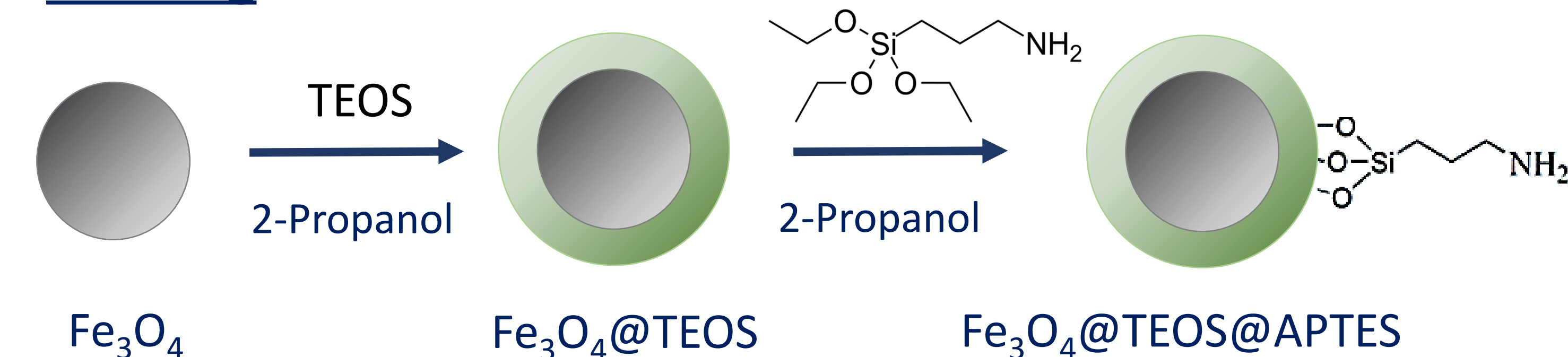
- Industrial wastewater contains considerable amounts of heavy metals (Pb, Hg, Cr, Ni, Cd, Cu, and Zn) that may endanger the environment and public health [1].
- Main chromium pollution industries: leather tanning, metal finishing, nuclear power plant, textile industries and chromate preparation [2].
- Nanoadsorbent advantages: non-complex and highly effective removal from multiphase systems, high selectivity, reusable [3].

Magnetic nanoadsorbents

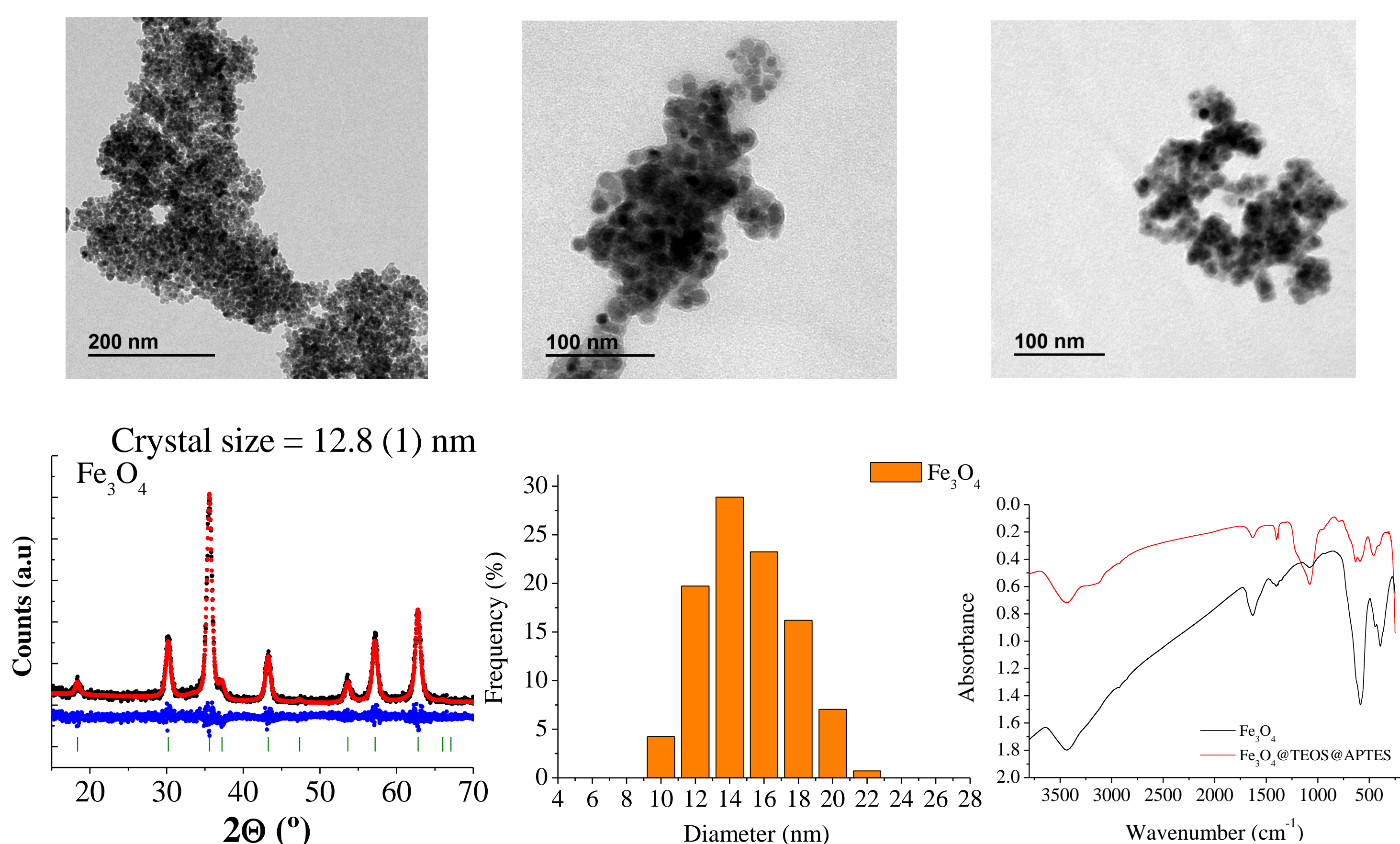
Synthesis



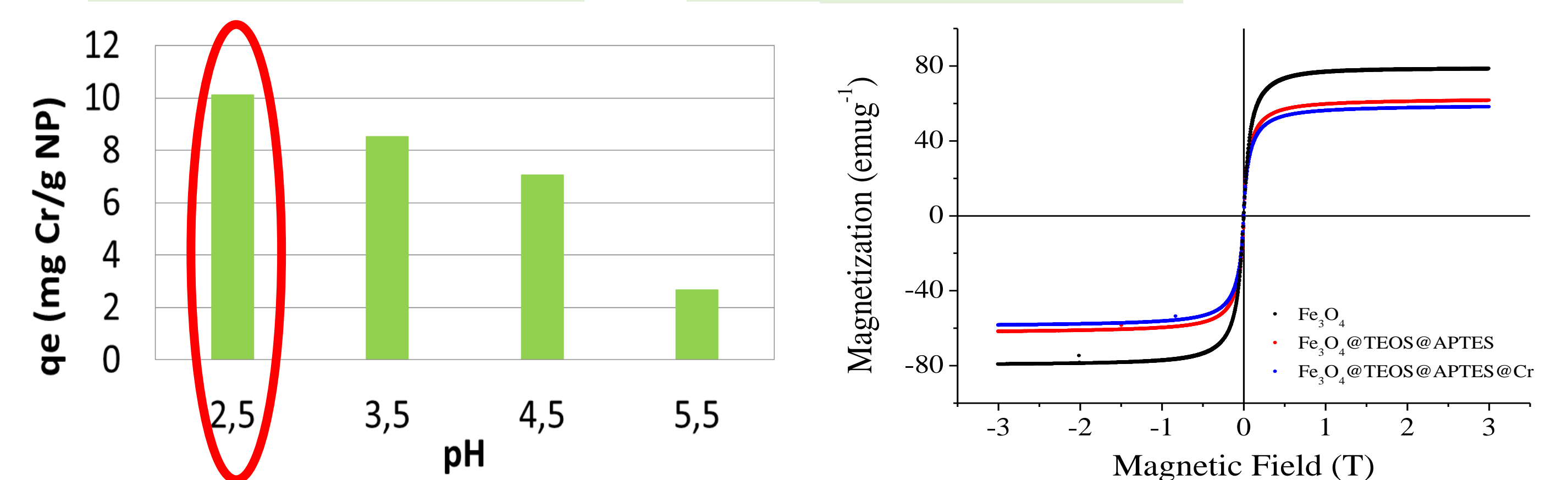
Grafting



Characterization

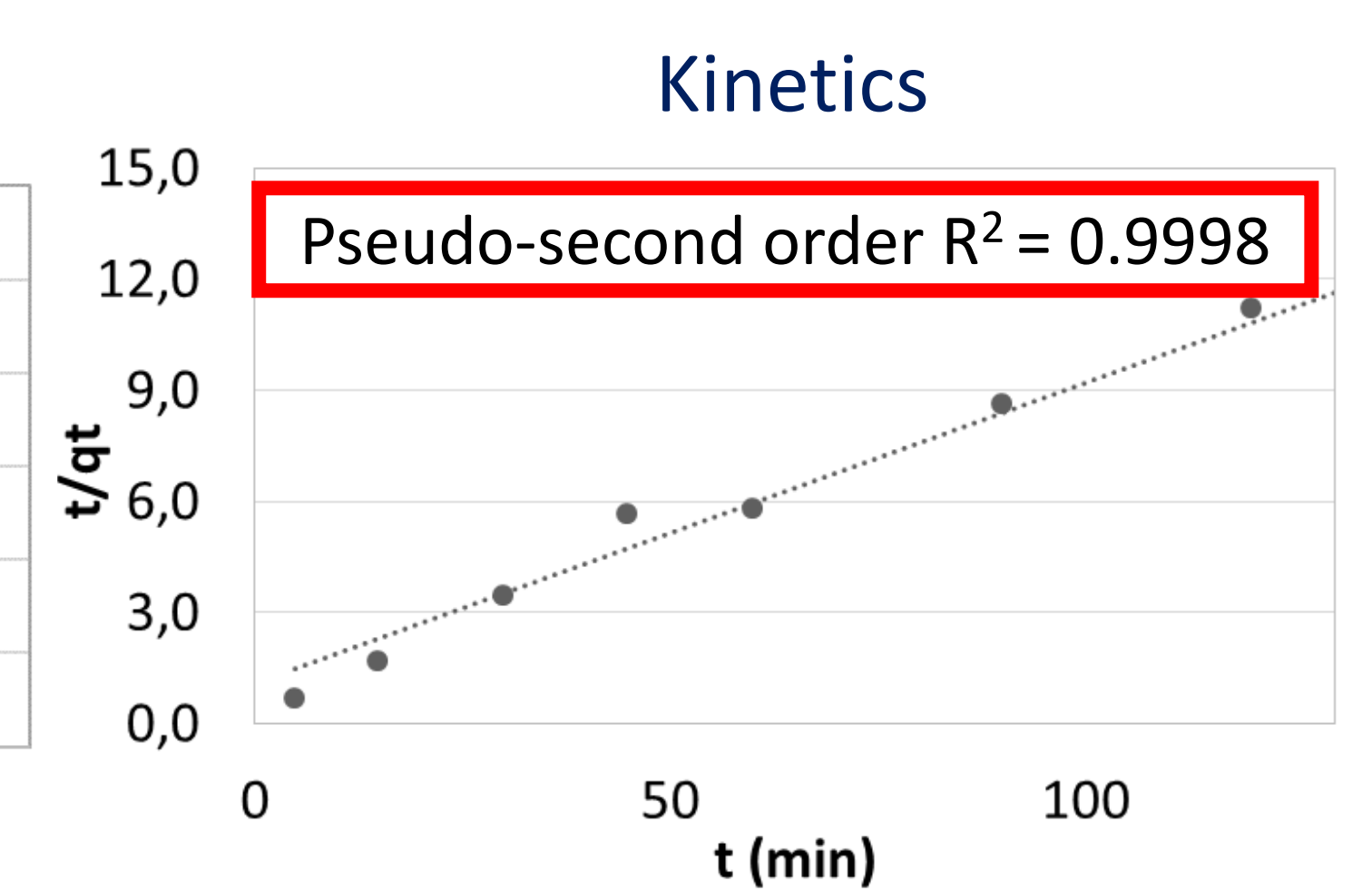
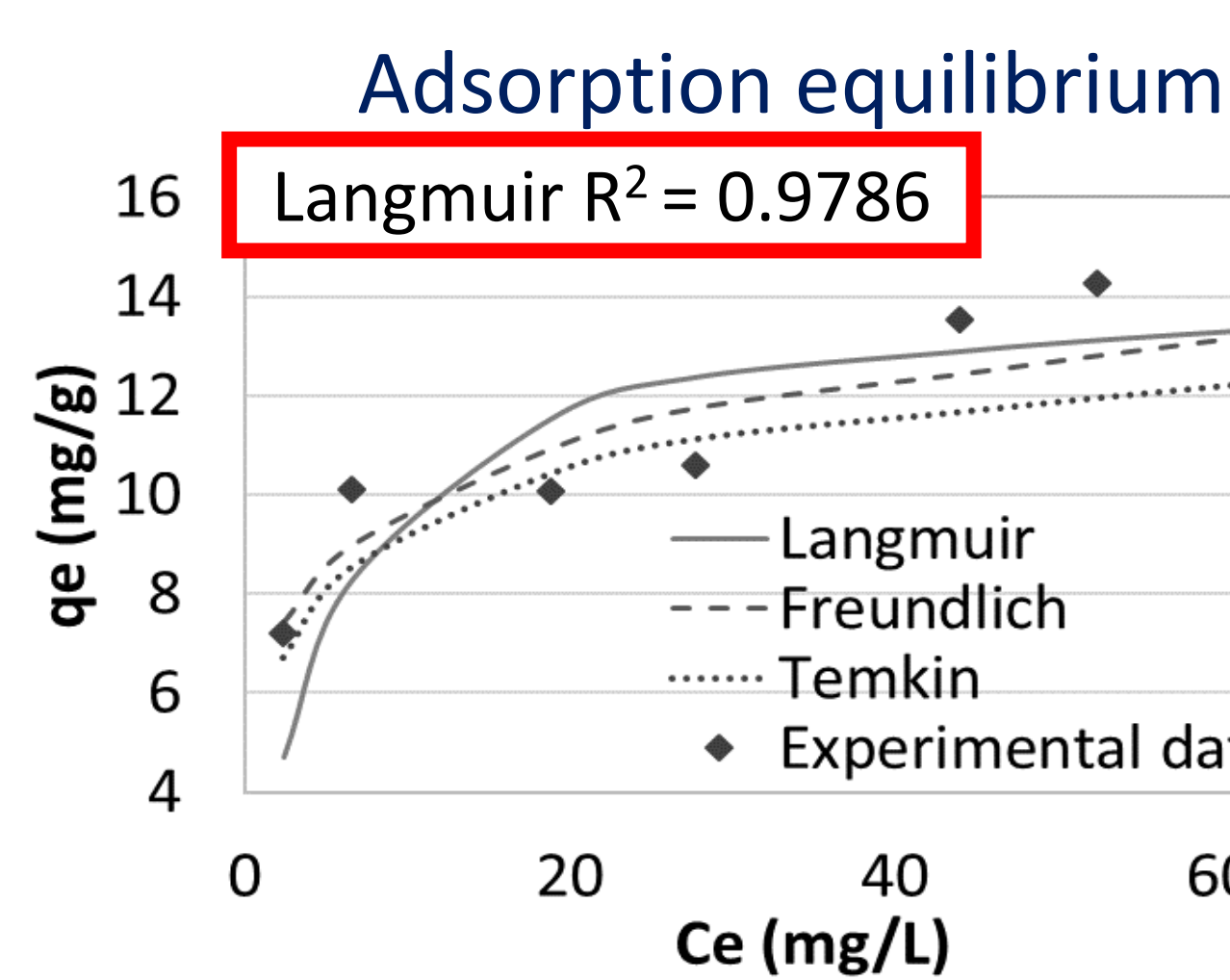


Chelation test



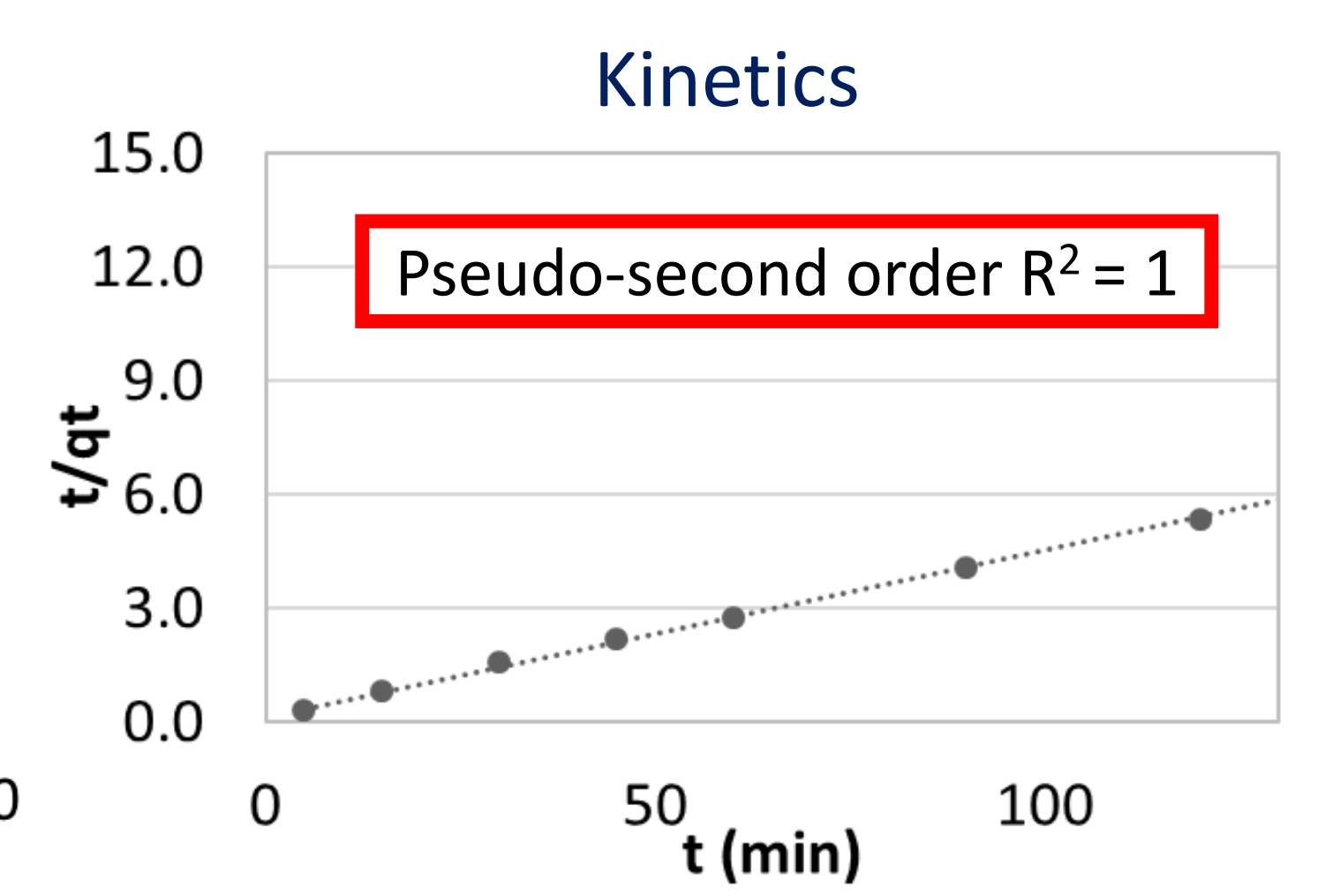
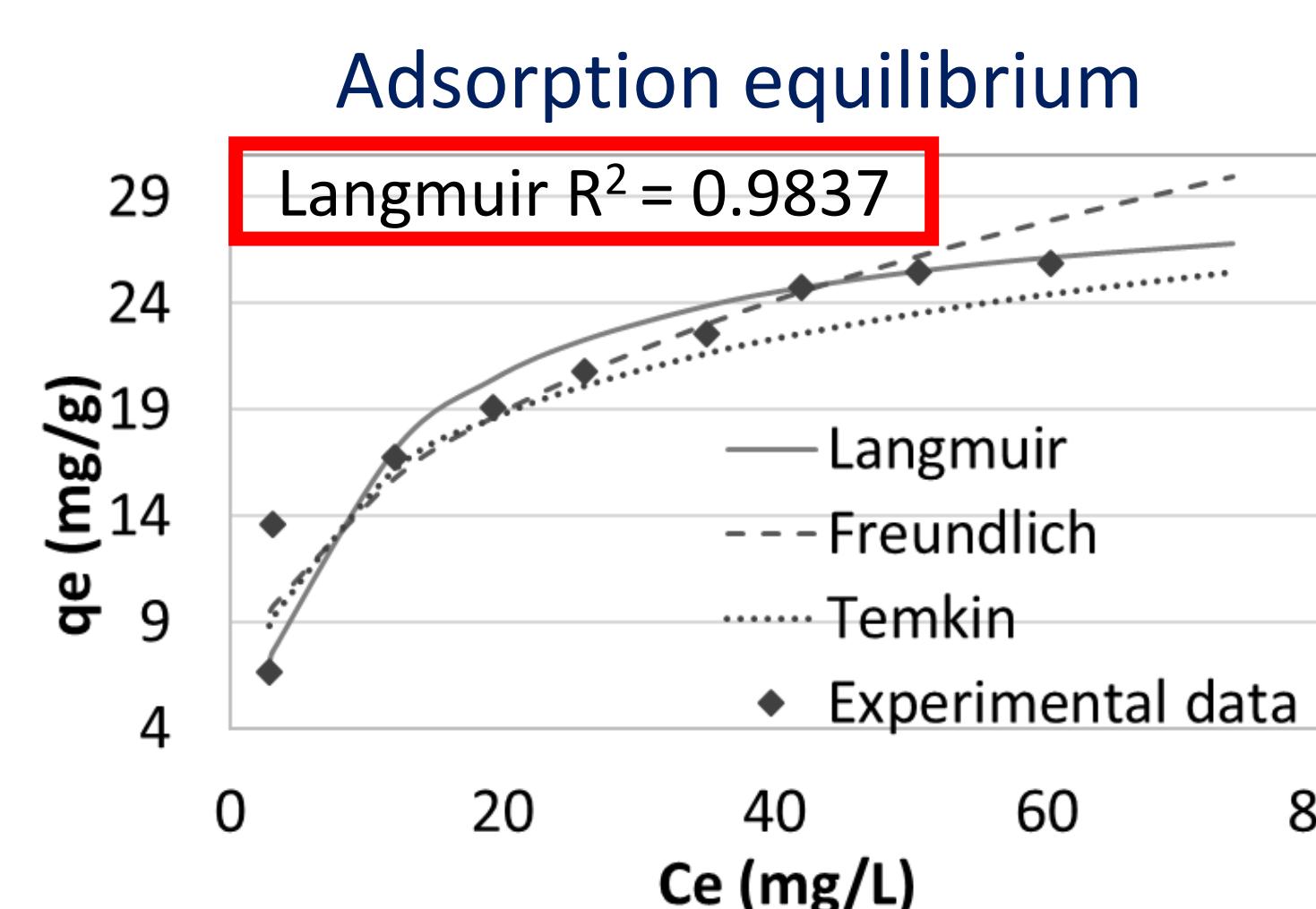
Fe_3O_4

$q_{\max} = 15 \text{ mg Cr/g NP}$



Fe_3O_4 @TEOS@APTES

$q_{\max} = 30 \text{ mg Cr/g NP}$



Fe_3O_4 @TEOS

$q_{\max} = 0 \text{ mg Cr/g NP}$

Chromium ions in aqueous solution: $\text{Cr}_2\text{O}_7^{2-}, \text{HCrO}_4^-, \text{CrO}_4^{2-}, \text{HCrO}_4^{2-}$

	TEOS	Fe_3O_4	APTES
Zeta Potential (mV)	1.79	25.9	34.2
q_{\max} (mg Cr/g NP)	~ 0	15	30

pH = 2.5

Conclusion

Iron oxide magnetic nanoparticles present better adsorption capacities for chromium removal at optimum conditions, when the grafting allows a positive surface charge.

References

- [1] S. Rengaraj et al. / Journal of Hazardous Materials B87 (2001), 273–287
- [2] N.H. Kera et al. / Journal of Colloid and Interface Science 503 (2017), 214–228
- [3] A. S. Helal et al. / J. Environ. Sci. Nano 5 (2018), 158–168