



HAL
open science

Investigation of the growth of nanoparticles with controlled size and controlled surface chemistry, which will be used as nanofillers in polymers

Sakina Mefath, Fahmi Bedoui, Isabelle Lisiecki, Djimédo Kondo, Anh-Tu Ngo

► To cite this version:

Sakina Mefath, Fahmi Bedoui, Isabelle Lisiecki, Djimédo Kondo, Anh-Tu Ngo. Investigation of the growth of nanoparticles with controlled size and controlled surface chemistry, which will be used as nanofillers in polymers. International Symposium on Polymer Nanocomposites 2022: From Elaboration to Applications (ISPn), Sep 2022, Lorient, France. hal-04021776

HAL Id: hal-04021776

<https://hal.science/hal-04021776>

Submitted on 9 Mar 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

Investigation of the growth of nanoparticles with controlled size and controlled surface chemistry, which will be used as nanofillers in polymers

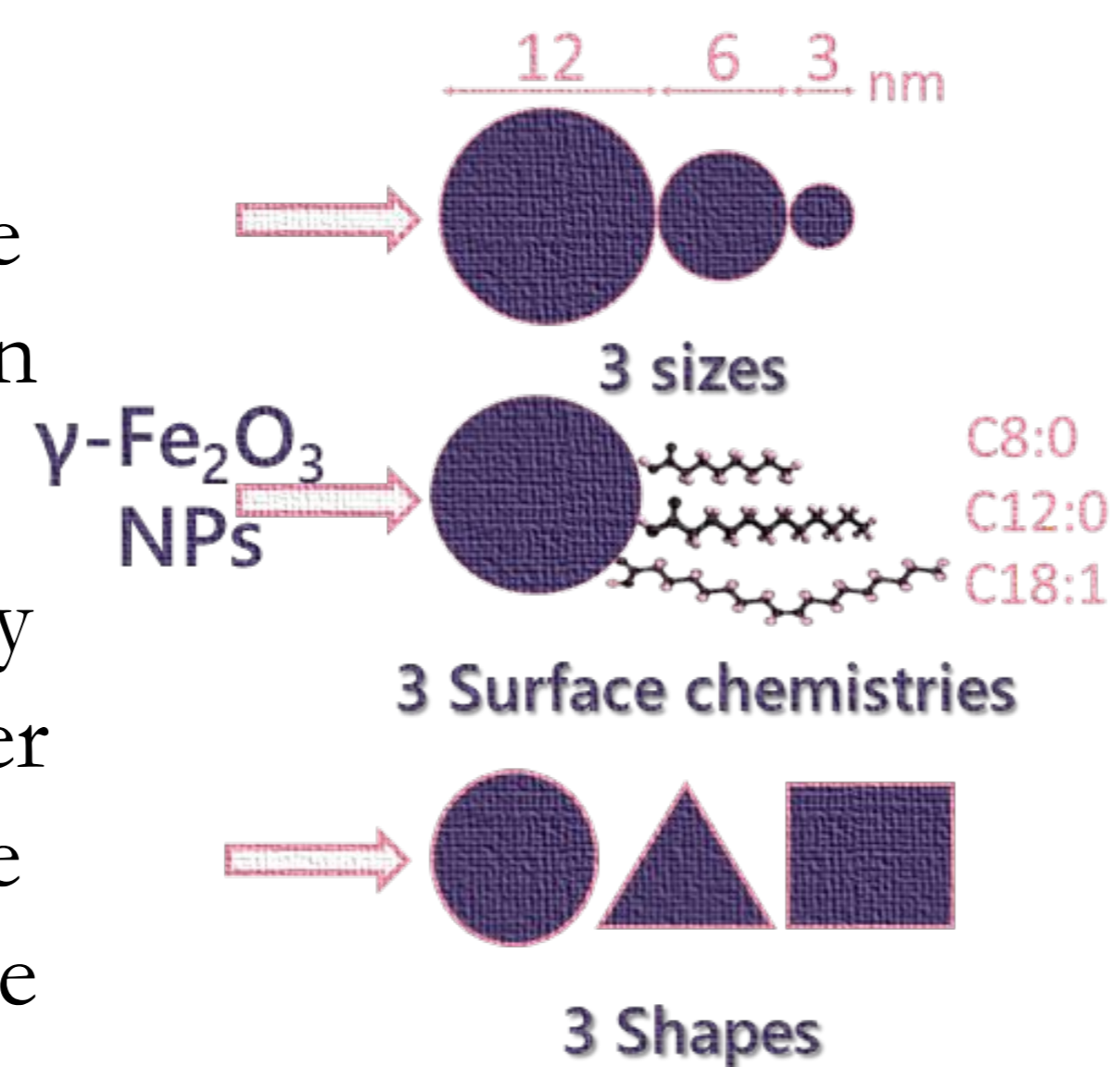
MEFTAH Sakina^{1,2} – BEDOUI Fahmi¹ – KONDO Djimédo³ – NGO Anh-Tu² – LISIECKI Isabelle²

Laboratoire Roberval UTC Compiègne¹ - Laboratoire Monaris Sorbonne Université² - Institut d'Alembert Sorbonne Université³
sakina.meftah@utc.fr

Context

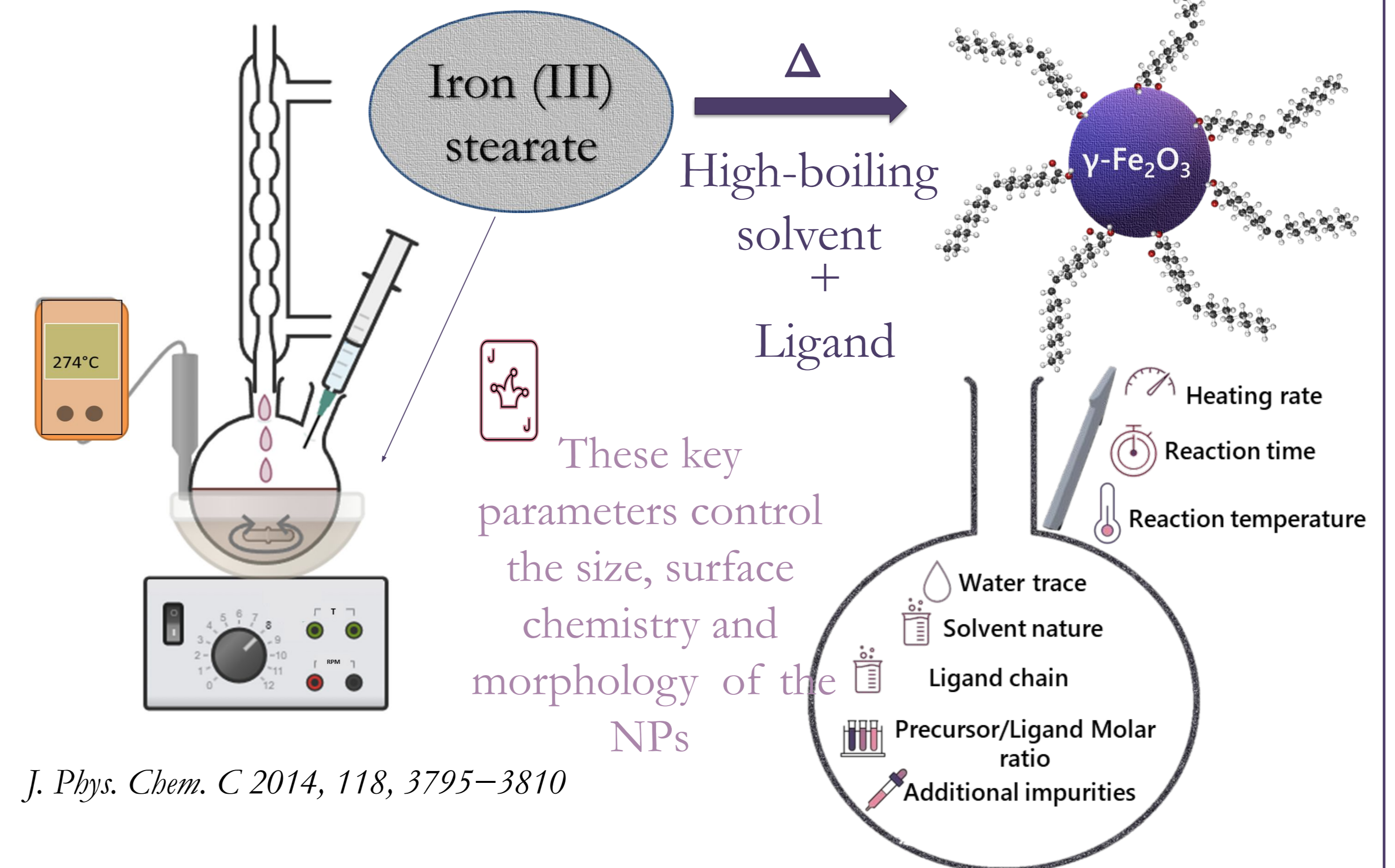
To Investigate the effects of size, surface chemistry and morphology of iron oxide nanofillers on the mechanical and thermal properties of nanoreinforced polymers:

1. Ligand-coated maghemite ($\gamma\text{-Fe}_2\text{O}_3$) nanoparticles are synthesized by the thermal decomposition of an organometallic precursor.
2. Growth mechanisms are revealed by studying the effect of each key parameter (mentioned in the next section) on the nanoparticle characteristics (size, surface chemistry, morphology).
3. Key parameter effects are exploited to control the characteristics of the nanoparticles to be incorporated. Envisaged characteristics: see the scheme



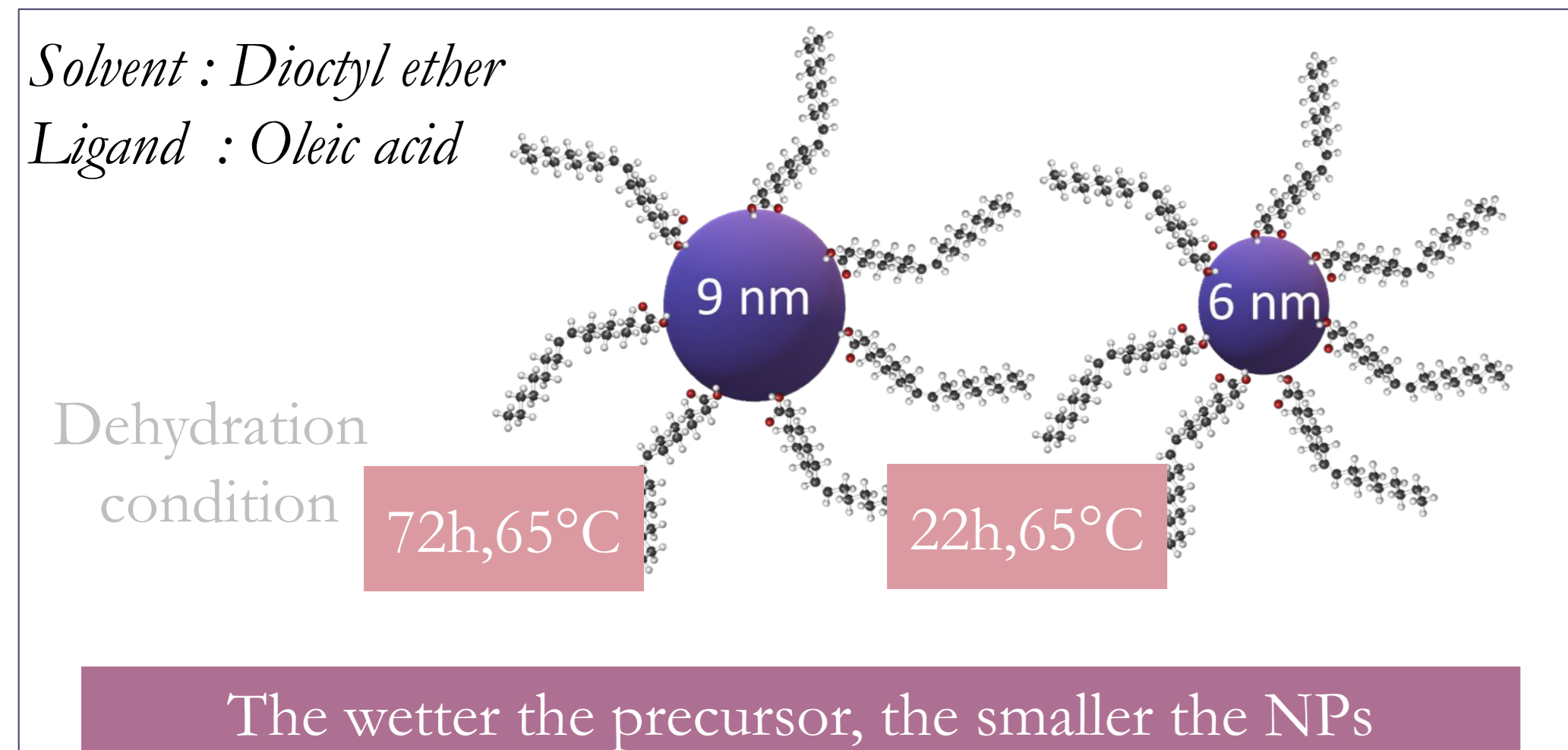
Synthesis of ligand-coated $\gamma\text{-Fe}_2\text{O}_3$ nanoparticles

Thermal decomposition process (under reflux)

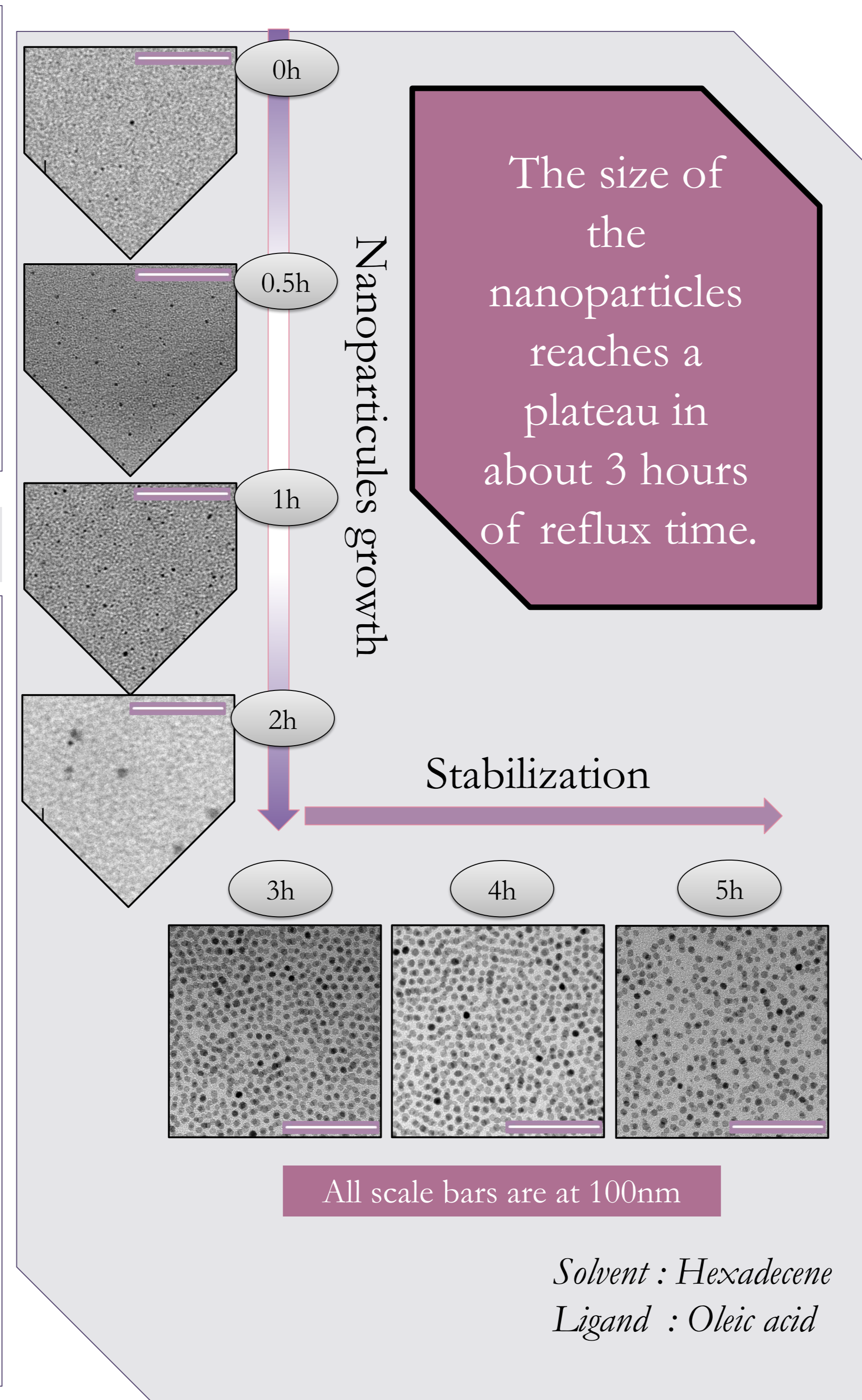


Key parameters for controlling nanoparticles growth

Water trace



Reflux time



Precursor impurities

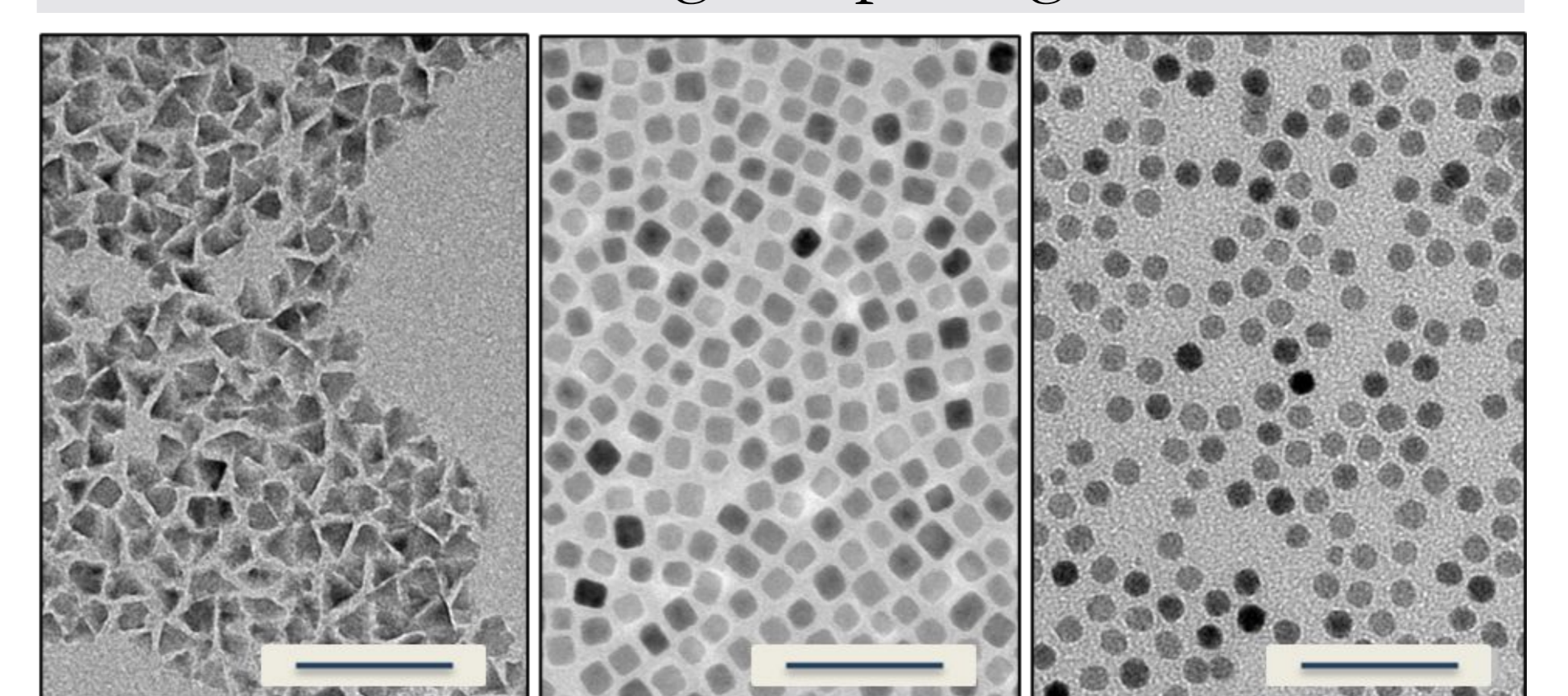
Synthesis of the precursor



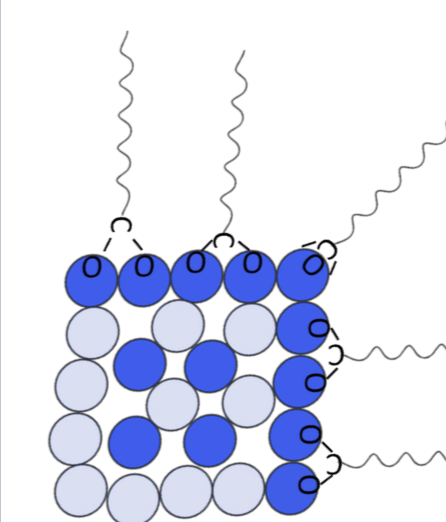
Microanalysis of the precursor used (% atomic)

	25	43	100
%Fe	25	43	100
%Na	48	54	0
%Cl	27	3	0

Resulting morphologies

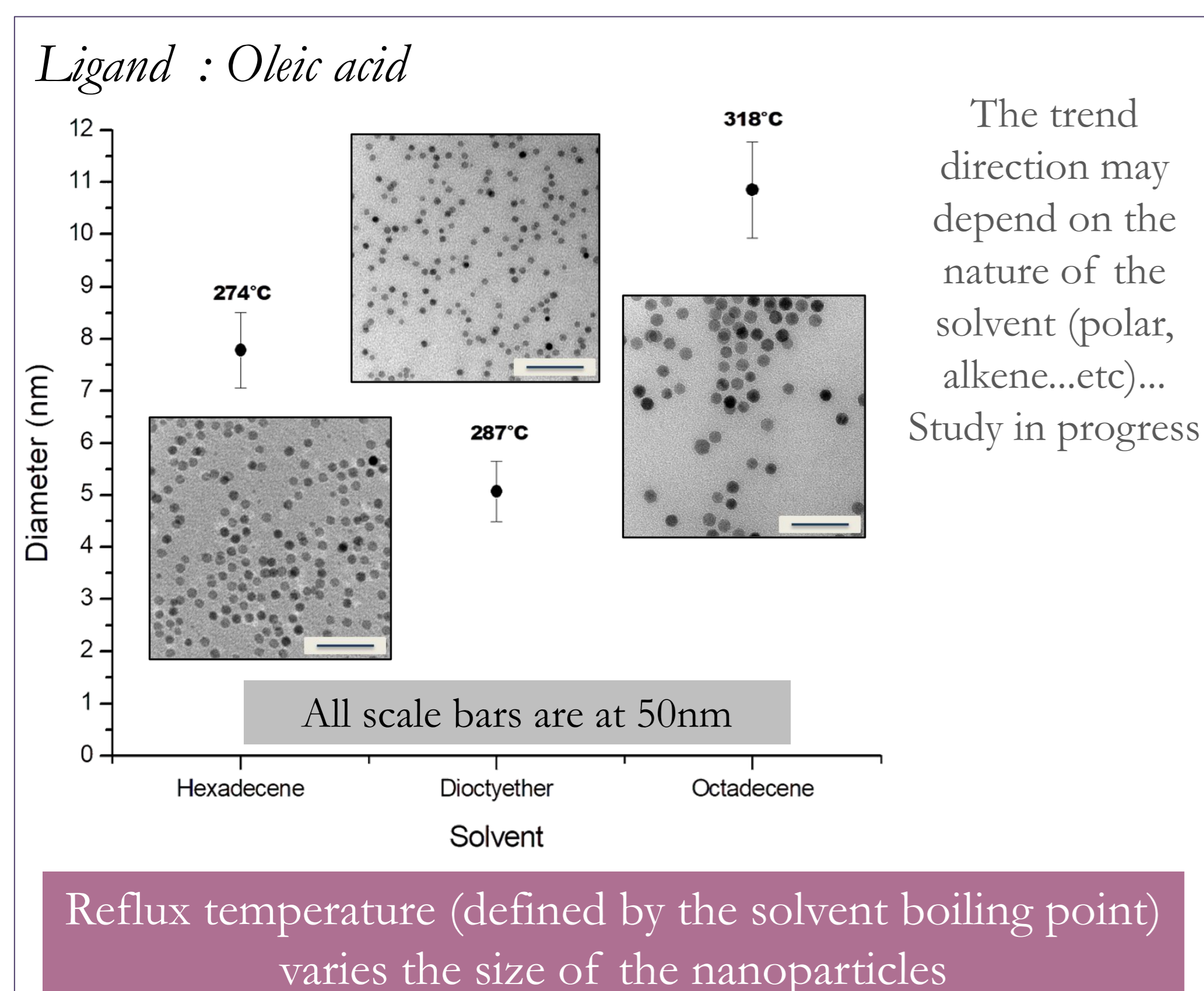


Solvent : Dioctyl ether
Ligand : Oleic acid



Poisoning the surface with different agents varies the growth rates on low index planes such as {111}, {110} and {100}.

Reflux temperature



Conclusion

Perspectives

- ✓ Series of experiments are conducted to understand the growth mechanism of iron oxide nanoparticles synthesised by thermal decomposition of an organometallic precursor.
- ✓ The effects of trace of water, temperature & reflux time, impurities in the precursor were observed.

- The understanding of the growth mechanism of the nanoparticles will be extended by studying the other key parameters mentioned in the "synthesis" section, and will be supported by a theoretical study on the solubility of the synthesis reagents.
- The study of control parameters will be explored to produce nanoparticles with controlled size, surface chemistry and morphology with low size dispersion to serve as nanofillers for a polymer matrix.
- The incorporation of nanoparticles into a polymer will reveal the evolution of the mechanical and thermal properties of the nanocomposite according to the characteristics of the inserted nanoparticles.