



HAL
open science

Synthesis of silicon nanoparticles through the decomposition of an azadipyromethene silicon complex

Megan Parker, Antoine Mazel, Lucien Roach, Cynthia Cibaka Ndaya, Alexander Castro Grijalba, Stanislav Pechev, Elisabeth A. Hillard, Mathieu Gonidec, Patrick Rosa, Glenna L. Drisko

► To cite this version:

Megan Parker, Antoine Mazel, Lucien Roach, Cynthia Cibaka Ndaya, Alexander Castro Grijalba, et al.. Synthesis of silicon nanoparticles through the decomposition of an azadipyromethene silicon complex. The Nanoscience Meeting - C'NANO 2021, Nov 2021, Toulouse, France. hal-04726789

HAL Id: hal-04726789

<https://hal.science/hal-04726789v1>

Submitted on 8 Oct 2024

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.

SYNTHESIS OF SILICON NANOPARTICLES THROUGH THE DECOMPOSITION OF AN AZADIPYRROMETHENE SILICON COMPLEX

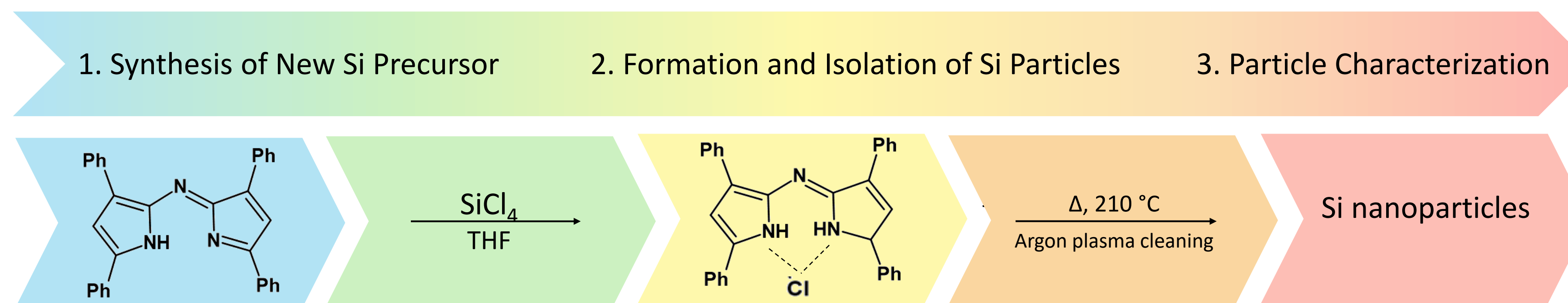


Megan Parker, Antoine Mazel, Lucien Roach, Cynthia Cibaka Ndaya, Alexander Castro Grijalba, Stanislav Pechev, Elizabeth A. Hillard, Mathieu Gonidec, Patrick Rosa, and Glenna L. Drisko



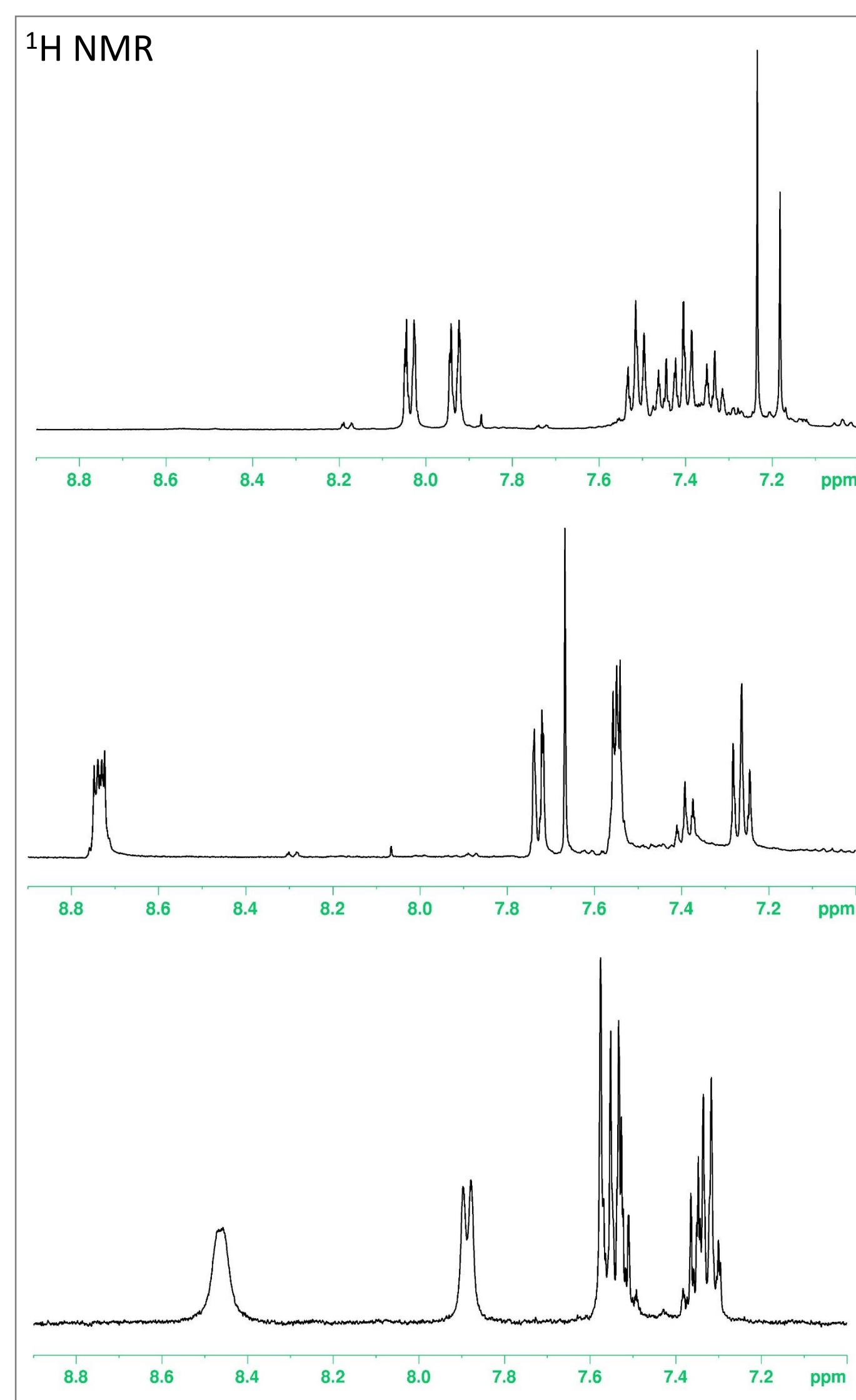
Institut de Chimie de la Matière Condensée de Bordeaux, CNRS, Bordeaux, France

Silicon particles are used in dielectric metamaterials because of their high refractive index and low absorption coefficient for visible light¹. While crystalline silicon has exceptional optical properties in comparison to other materials, it is very difficult to synthesize stable silicon nanomaterials². This poster presents a more flexible bottom-up synthesis method to produce silicon. The route involves a multi-step synthesis of an azadipyrromethene (Azadpm) coordination complex³, followed by its thermal decomposition to afford silicon nanoparticles. Thermal decomposition is carried out using three methods to explore the effect of gases and heating conditions on the resulting silicon nanoparticles. The three methods involve: microwave heating under argon, heating in an oil bath under argon, and heating in an oil bath under hydrogen. Under each condition the silicon precursor decomposes to silicon nanoparticles; however, microwave heating and oil bath heating under hydrogen gas both favor nanoparticle nucleation, resulting in a paucity of precursor available for particle growth. Microwave heating under argon promotes the growth of larger, cubic nanoparticles, that are 25-35 nm in diameter.

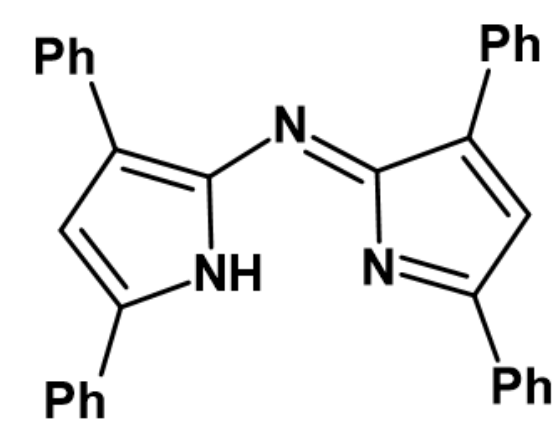


1. Synthesis of New Si Precursor

2. Formation and Isolation of Si Particles

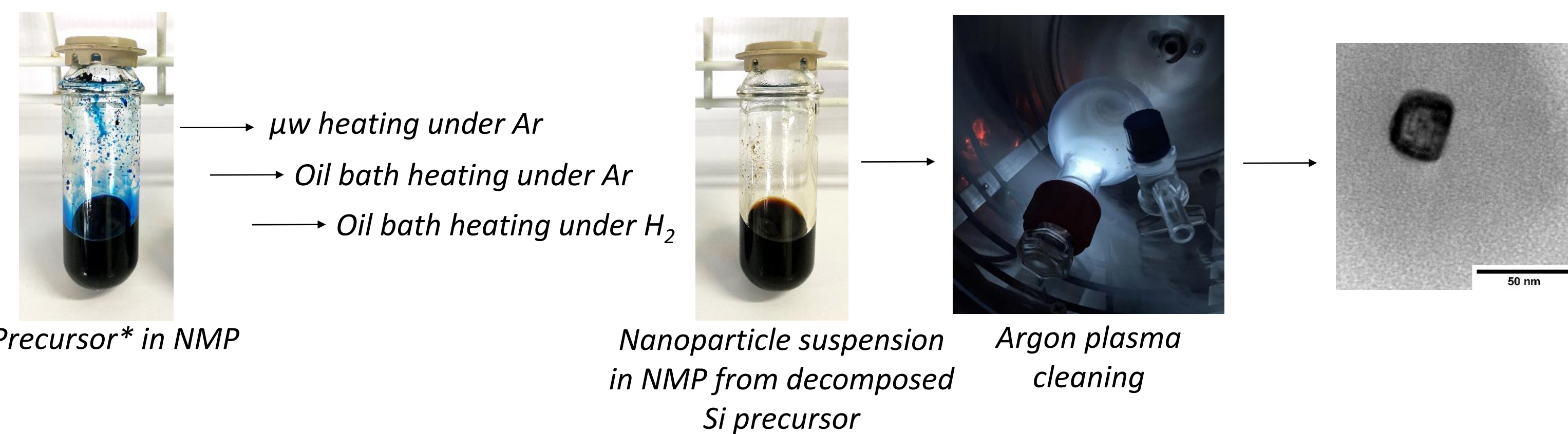
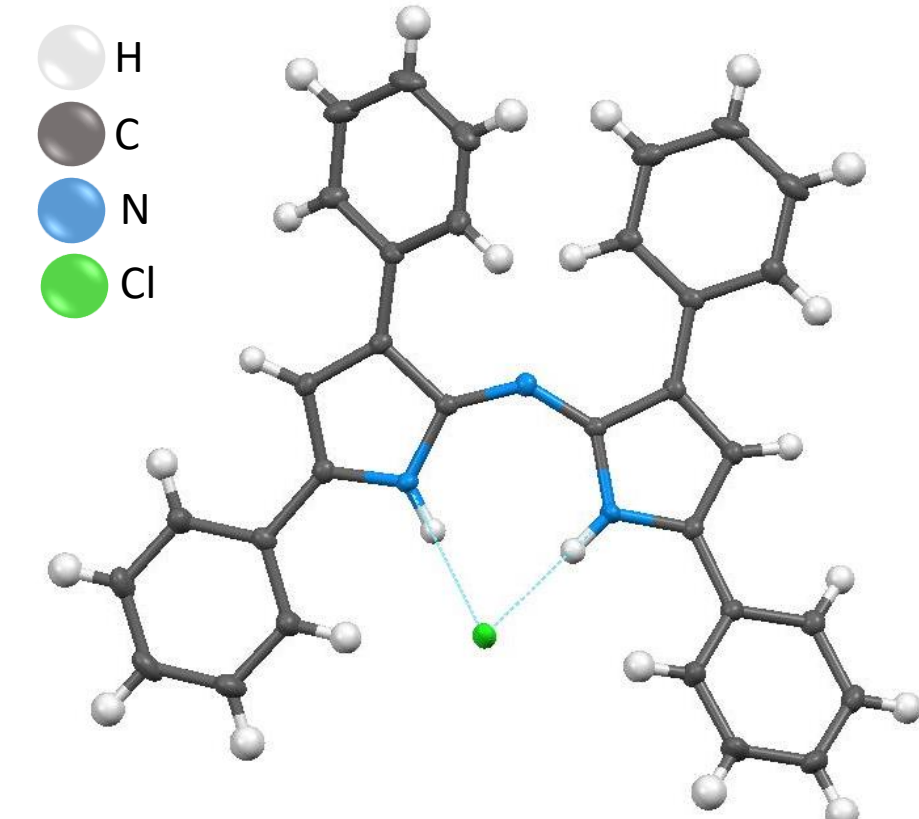


Starting Material: Azadipyrromethene

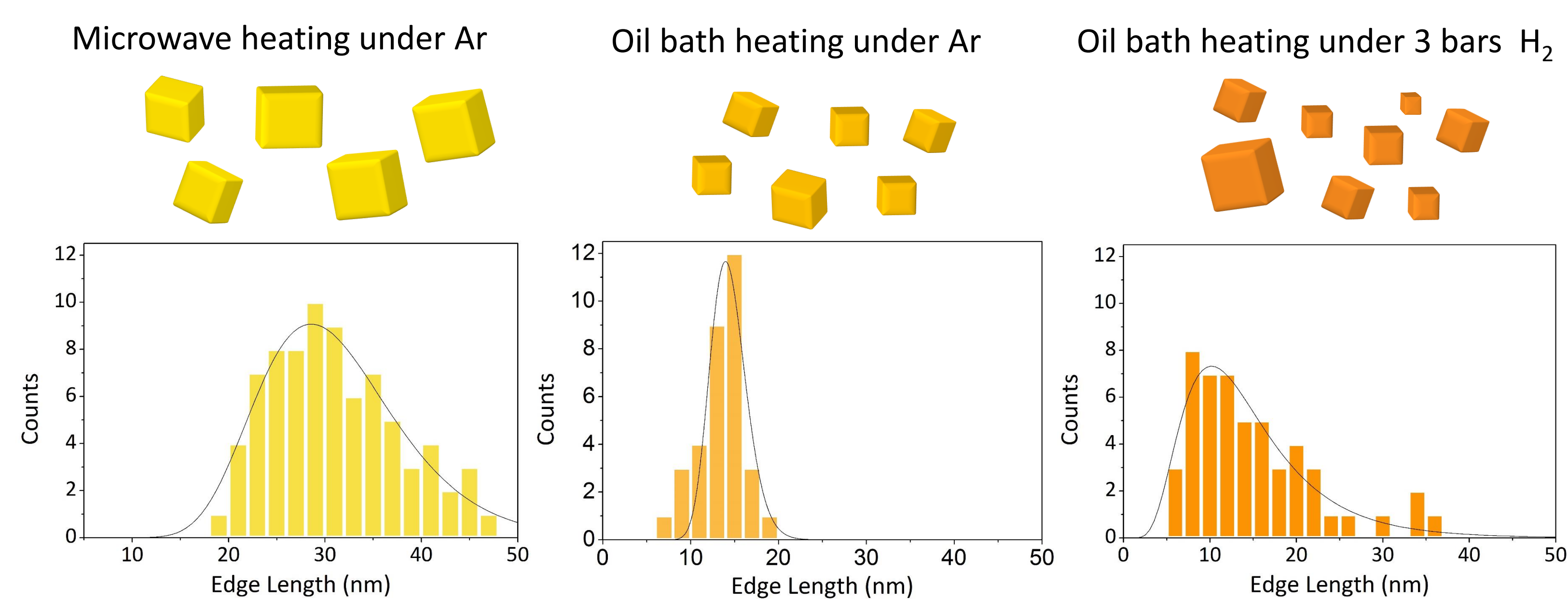


Si Precursor (Isolated Powder)

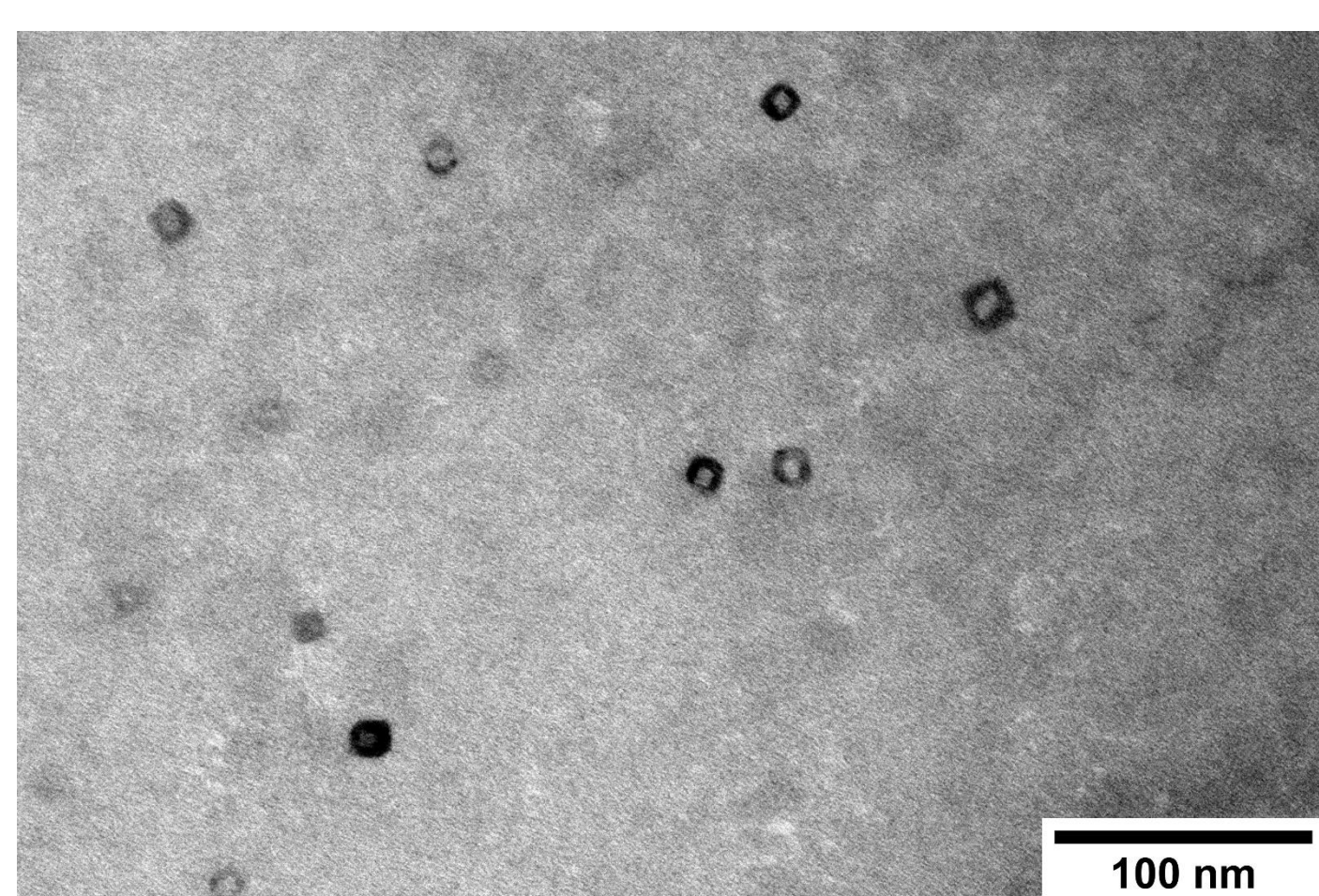
Crystallized *Si Precursor*



Resulting Particle Size Distributions



3. Particle Characterization

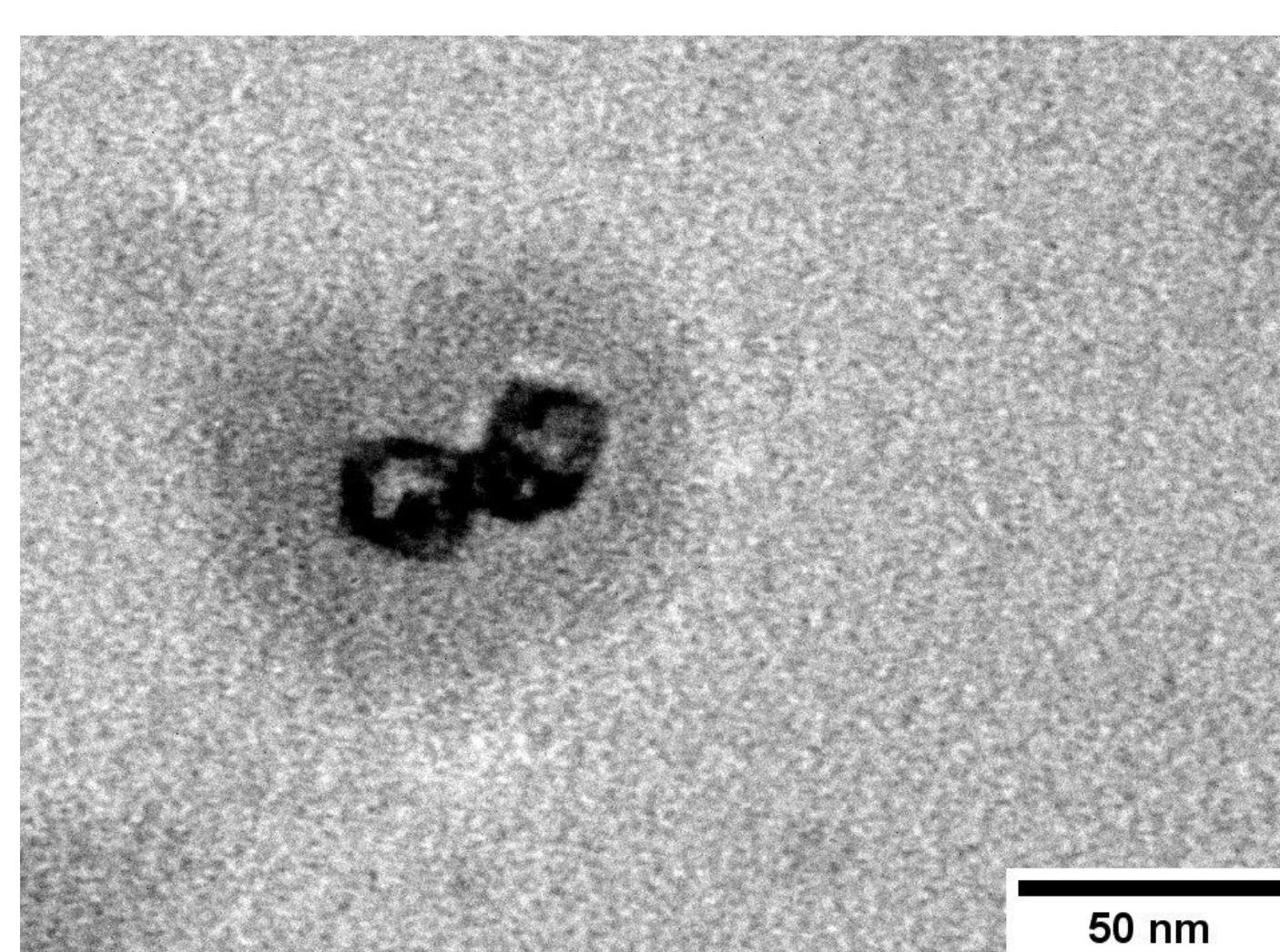
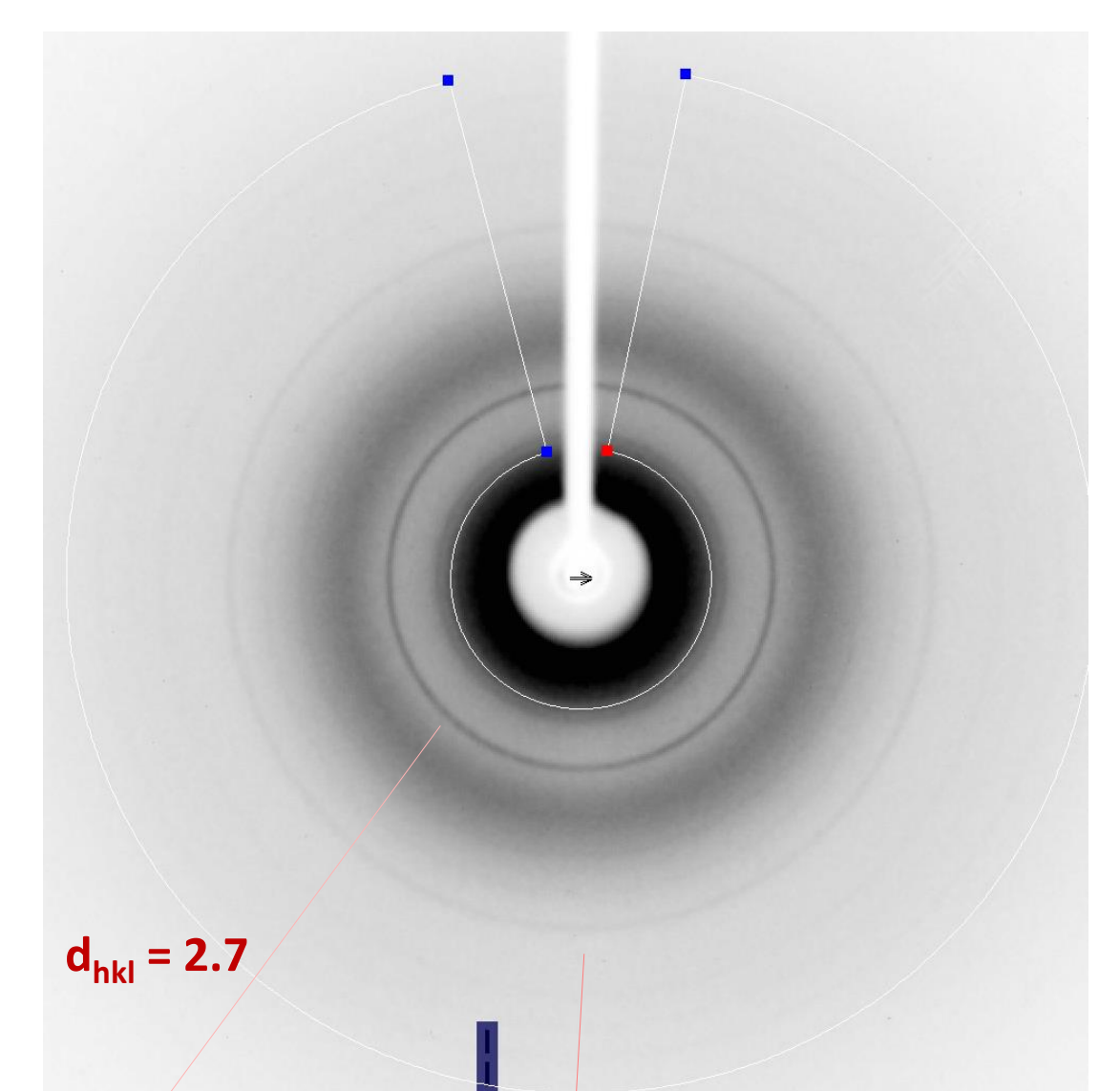


Particles:

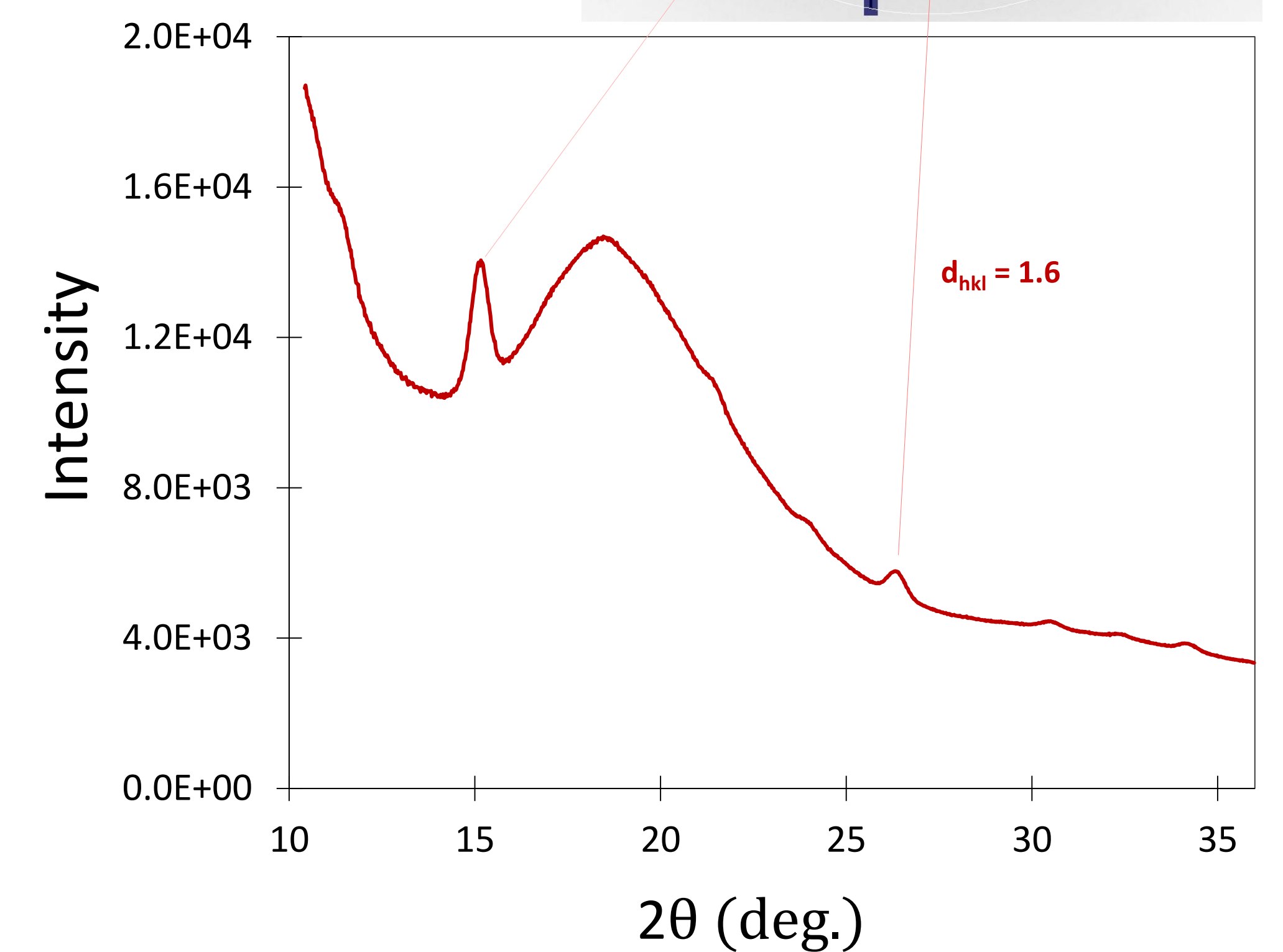
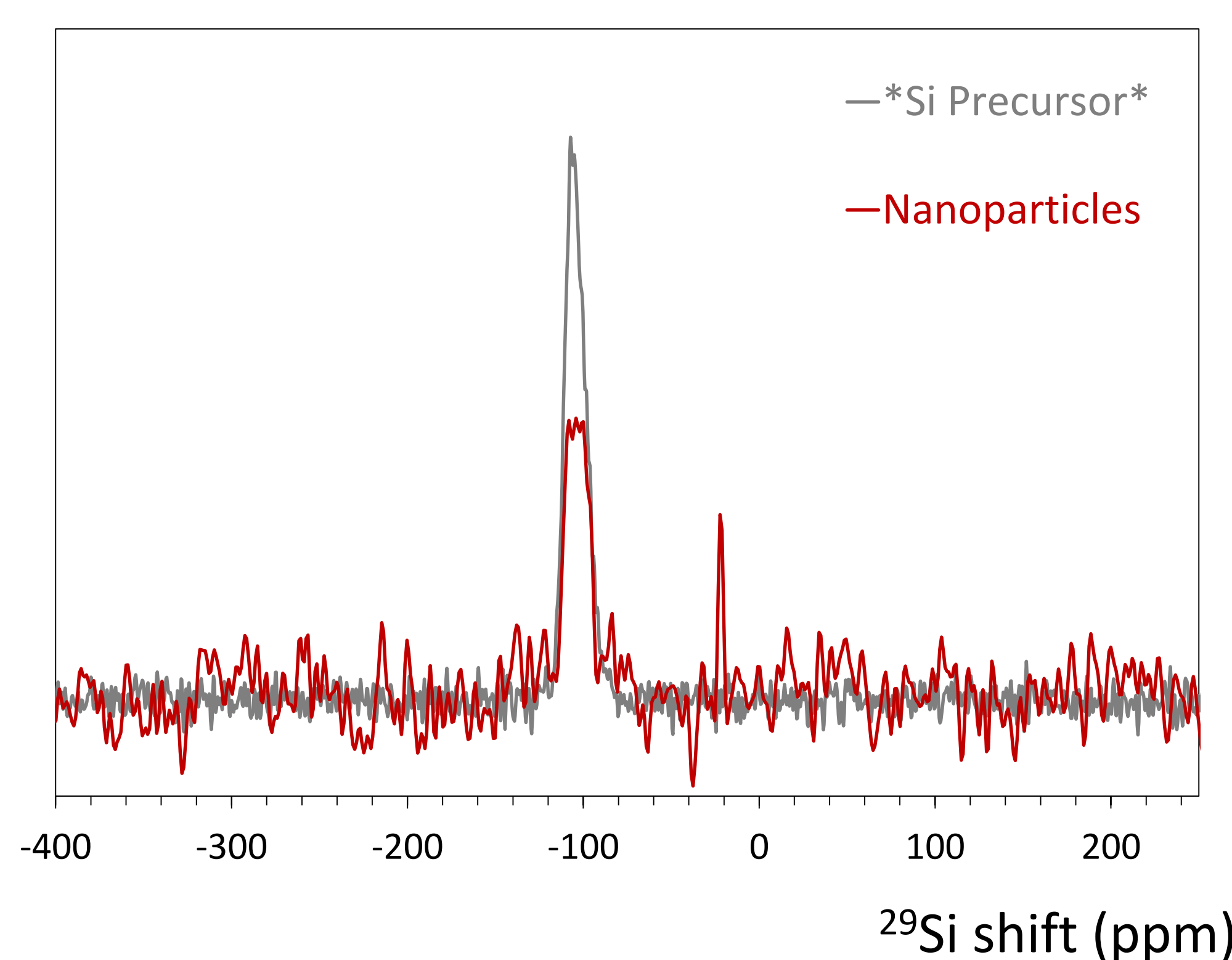
- Cubic
- ≤45nm in edge length
- Pure Si

XRD:

- Particles diffract well
- Diffraction pattern does not match any existing in the literature



²⁹Si MAS NMR



[1] Hinamoto T., Hotta S., Sugimoto H., Fujii M., *Nano Lett.*, 2020, 20 (10), 7737-7743.
 [2] De Marco M.L., Semlali S., Korgel B.A., Barois P., Drisko G., Aymonier C., *Angewandte Chemie*, 2018, 57 (17), 4478-4498.
 [3] Baudron, S., *Dalton Trans.*, 2013, 7498-7509
 This project received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Grant agreement No. 948319).



ICMBC-CNRS, Université de Bordeaux
 87 avenue du Dr. Albert Schweitzer
 33608 PESSAC Cedex
 www.icmcb-bordeaux.cnrs.fr