



# Chemical Insights into the Preparation of Multifunctional Metal-Oxide Nanoparticles for Enhanced Imaging and Theragnostic

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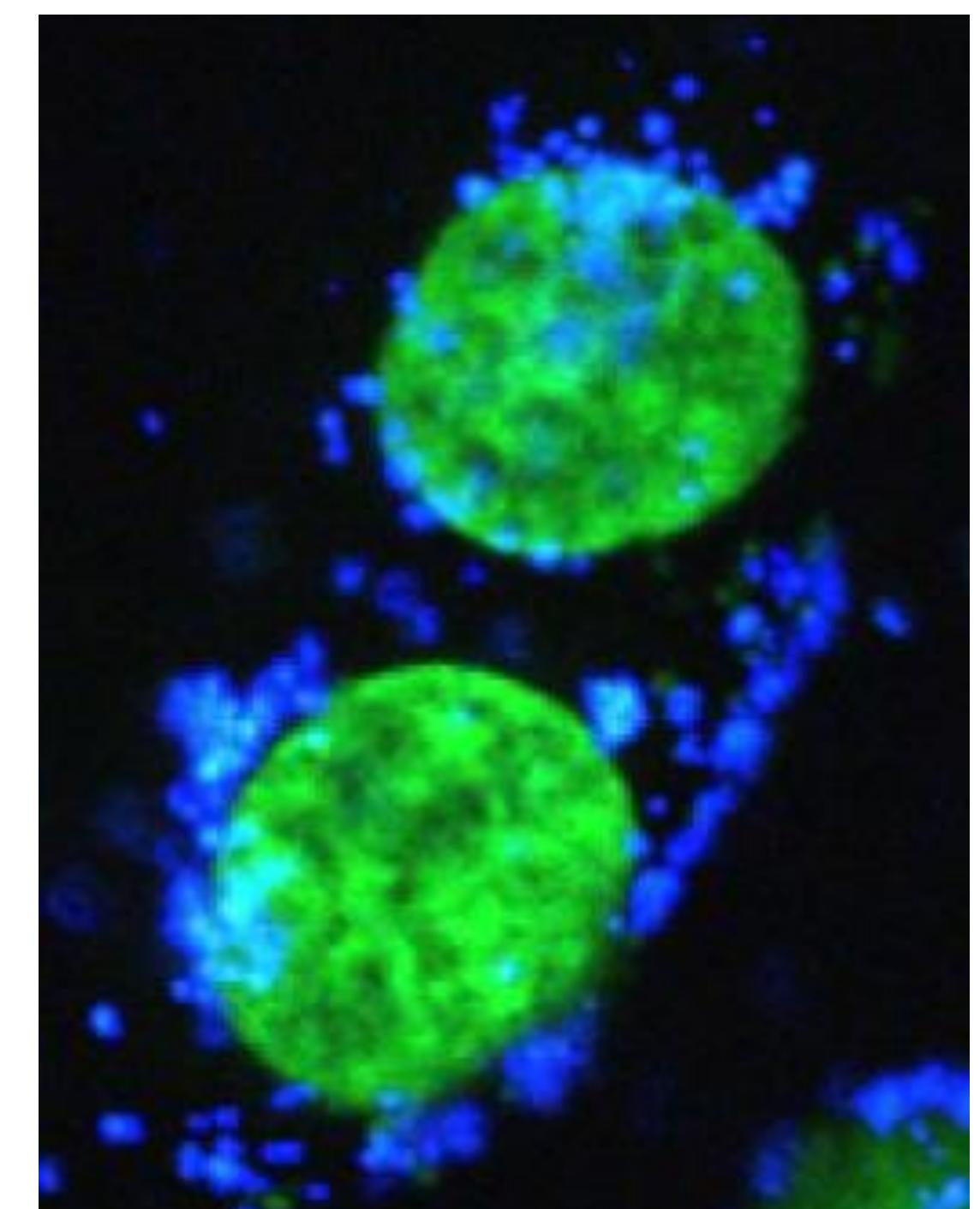
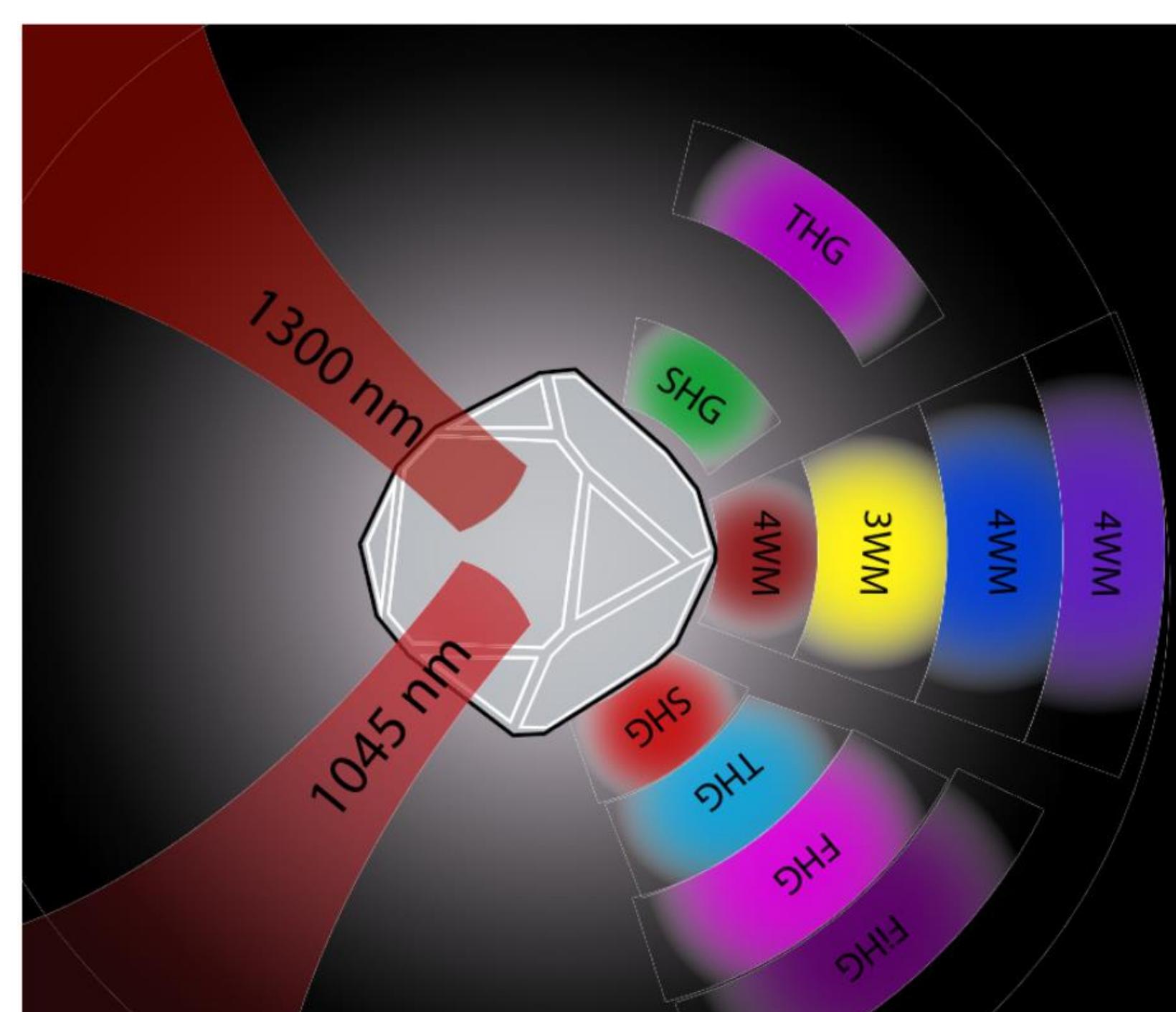
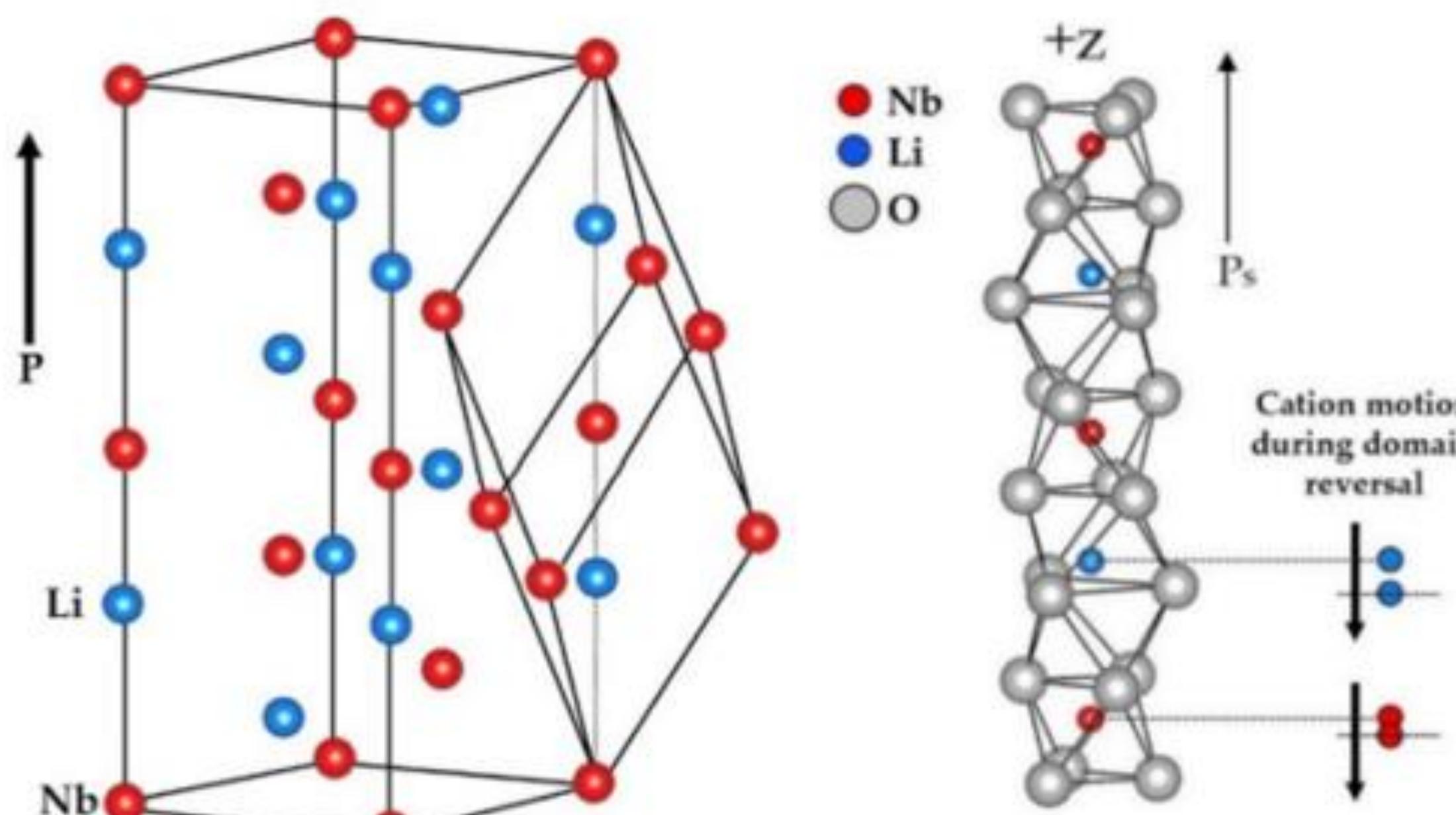
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# Chemical Insights into the Preparation of Multifunctional Metal-Oxide Nanoparticles for Enhanced Imaging and Theragnostic

Ameni Dhouib<sup>1</sup>, Tianhao Guo<sup>1</sup>, Emilie Molina<sup>1</sup>, Sandrine Beauquis<sup>1</sup>, Virginie Monnier<sup>2</sup>, Ronan Le Dantec<sup>1</sup>, Yannick Mugnier<sup>1</sup>

**Objective:** the development of multimodal agents capable of generating multiple contrasts through various physical mechanisms, including MRI, CT, luminescence, and nonlinear processes

## Introduction:



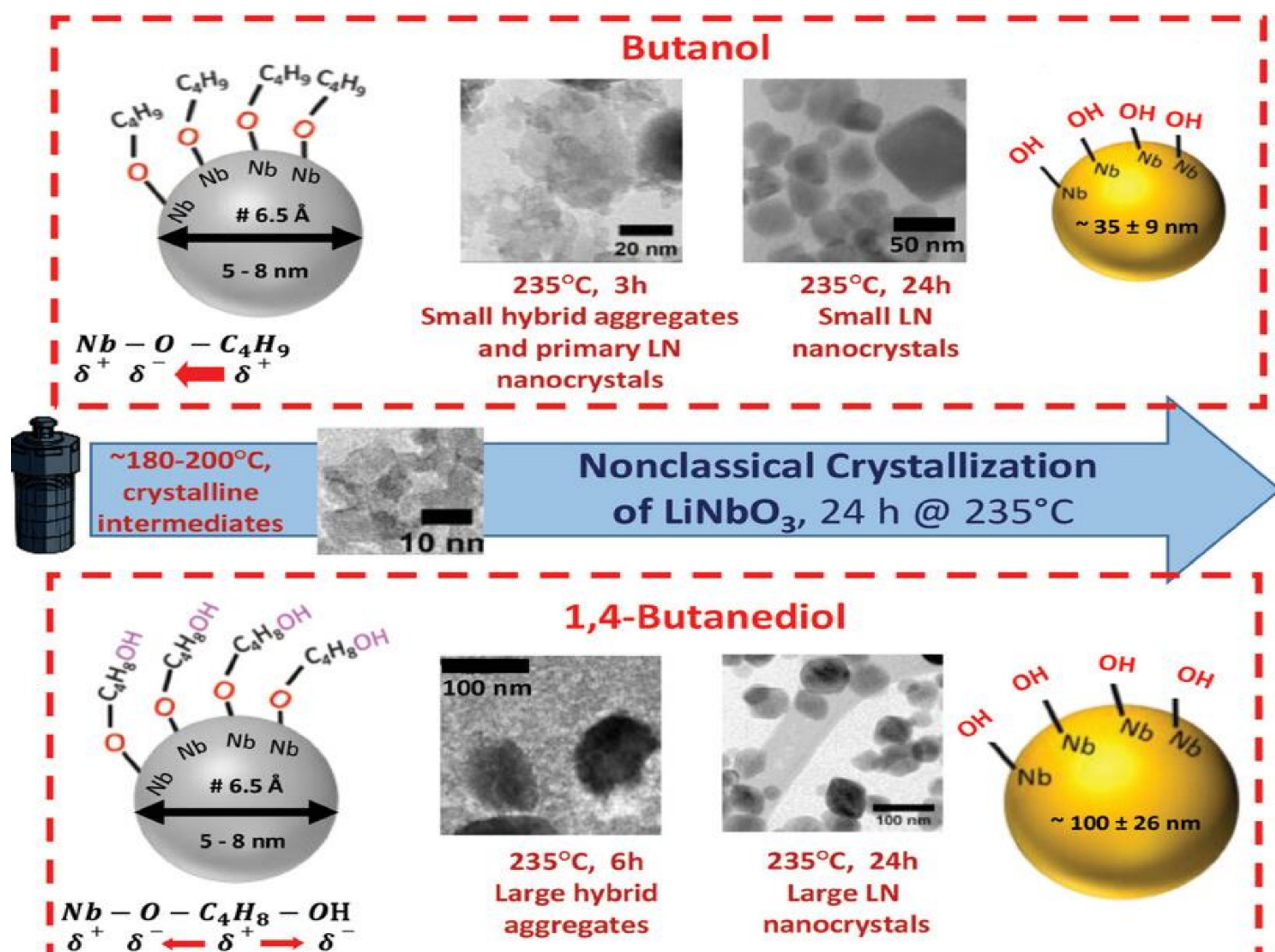
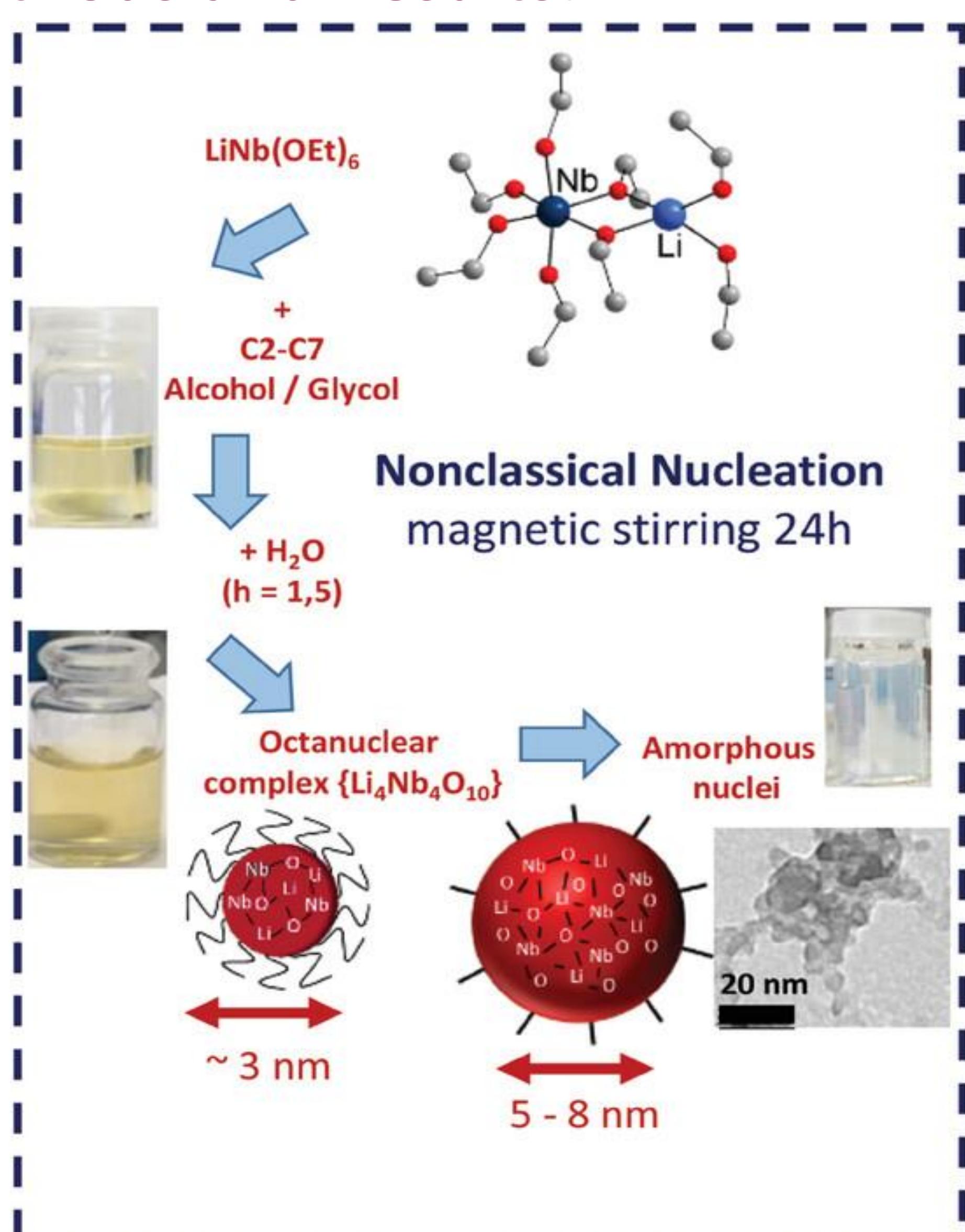
Conventional rhombohedral and hexagonal unit cells in  $\text{LiNbO}_3$ , with the oxygen atoms omitted.[1]

Tunable excitation wavelengths allow for the generation of different optical properties.[2]

Green : stained cancer cell (fluorescence)  
Fades after : minutes  
Blue : harmonic NPs (SHG)  
Fades after : hours up to days!

**Non-centrosymmetric structure → Non-linear optical properties (SHG, THG.. and 4WM)**

## Methods and Results:

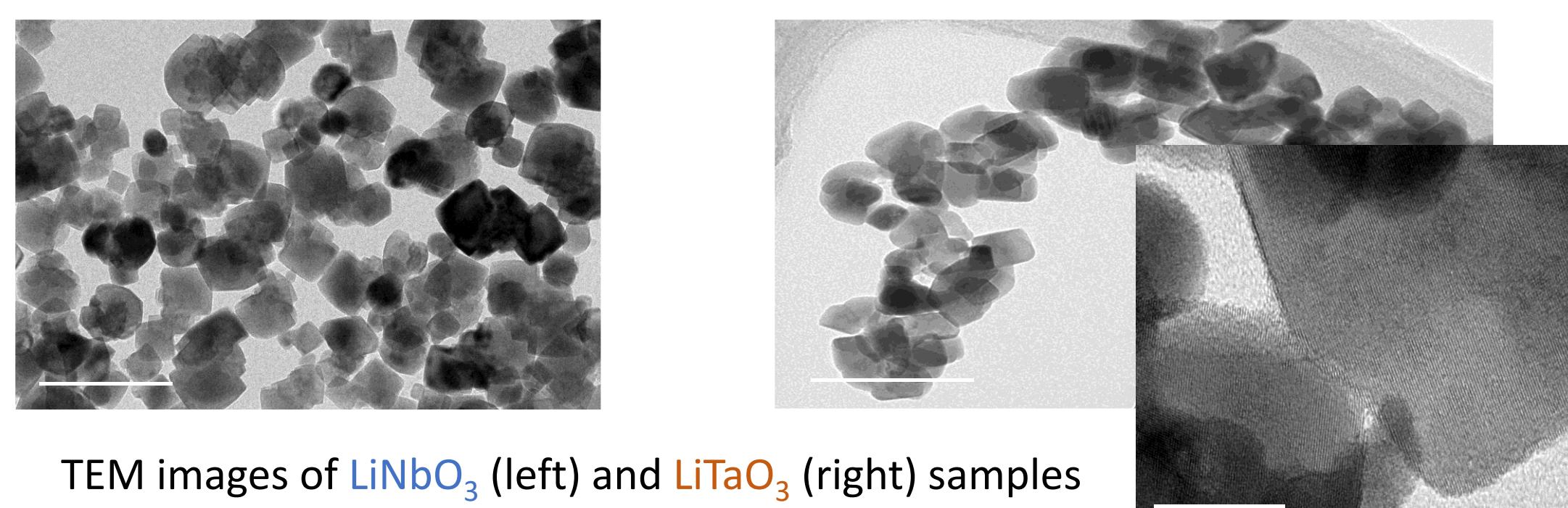


Overview of the nonclassical nucleation scheme and aggregation-mediated crystallization process with a special focus on the butanol and 1,4-butanediol co-solvents. [3]

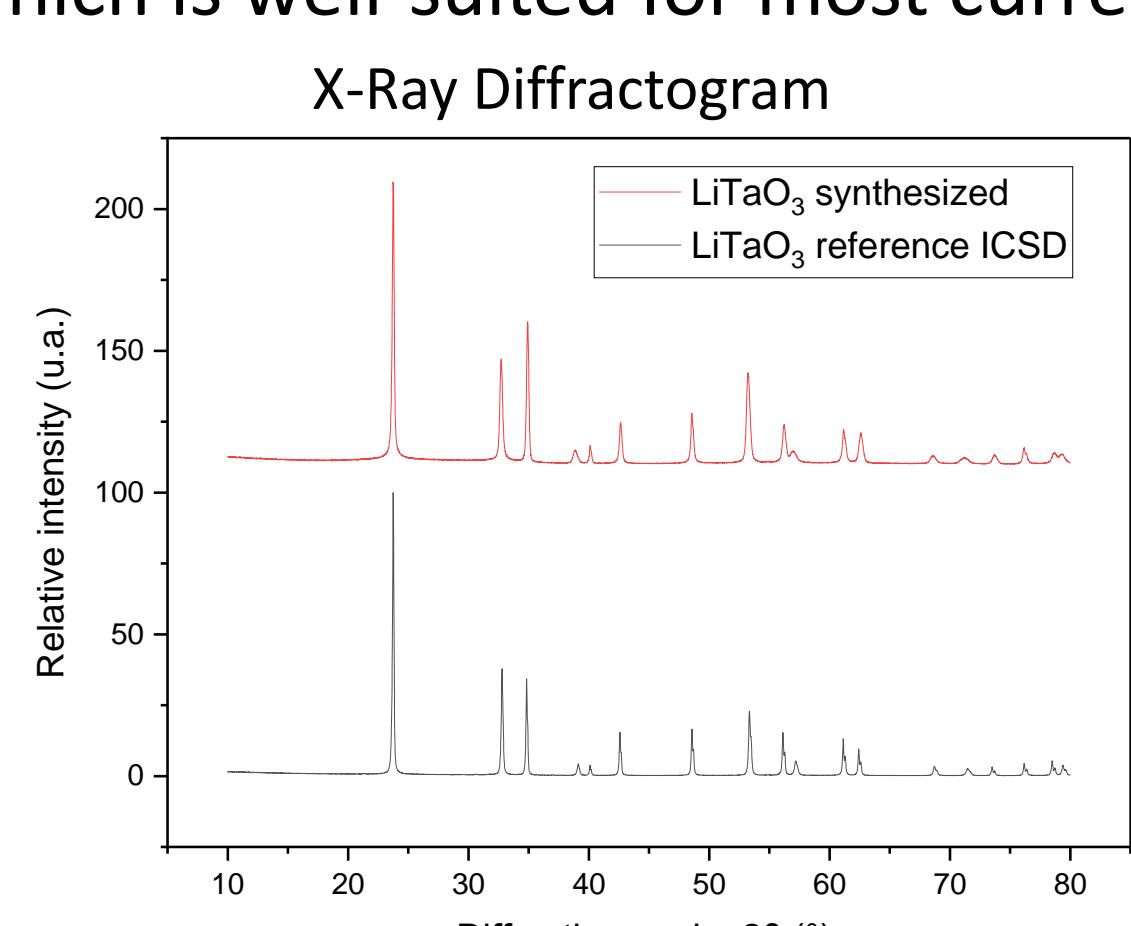
## A step further:

### Substituting Nb with Ta :

A higher CT contrast is expected since tantalum has a K-edge at 67.4 keV which is well-suited for most current CT scanners. → New feature added to the nanoprobe.



TEM images of  $\text{LiNbO}_3$  (left) and  $\text{LiTaO}_3$  (right) samples



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## References:

- [1]. Oswaldo Sánchez-Dena, et al. Lithium niobate single crystals and powders reviewed—part i. Crystals, 10(11):973, Oct 2020.
- [2]. Campargue, Gabriel, et al. "Multiorder Nonlinear Mixing in Metal Oxide Nanoparticles." Nano Letters 20.12 (2020): 8725-8732.
- [3]. Riporto, Florian, et al. "Nonclassical Nucleation and Crystallization of  $\text{LiNbO}_3$  Nanoparticles from the Aqueous Solvothermal Alkoxide Route." Small (2023): 2306417.