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► **To cite this version:**

Arnaud Dandre, Gilles Philippot, Mario Maglione, Jean-Marc. Bassat, Cyril Aymonier. Novel acetylacetonate precursors-based synthesis of Strontium Titanate nanoparticles in supercritical water/ethanol mixture. 19th European Meeting on Supercritical Fluids - EMSF 2023, International Society for the Advancement of Supercritical Fluids, May 2023, Budapest, Hungary. hal-04701835

HAL Id: hal-04701835

<https://hal.science/hal-04701835v1>

Submitted on 18 Sep 2024

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Novel acetylacetonate precursors-based synthesis of Strontium Titanate nanoparticles in supercritical water/ethanol mixture

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Climate change is a serious concern that needs to be considered in order to find solutions to reduce environmental risks. Due to fluctuating renewable energy sources, extra electricity storage options are needed. Co-electrolysis, which involves converting electrons from water and carbon dioxide into hydrogen and carbon monoxide is one way to contribute to solving this challenge. To go even further, the combination of hydrogen and carbon monoxide, produces methane through a power to gas process, which can finally be used to create hydrocarbons through the oxidative coupling of methane (OCM). Interestingly, energy consumption can be decreased by using such high-temperature electrolysis units. [1-2]

Perovskite ABO_3 catalysts have been intensively investigated as a material of choice for the OCM (oxidative coupling of methane) [3]. The properties needed for this application mainly deal with excellent thermal and chemical stability under OCM reaction conditions as well as mixed ionic/electronic conductivity (MIEC), in order to fit the requirements to achieve water or co-electrolysis.

The chosen material for this OCM catalytic application is $SrTiO_3$ (ST), for whose physical properties can be easily tuned through the doping of its cationic sites A and B. The conductivities, such as electronic and ionic conductivity, are the primary targets for these applications.

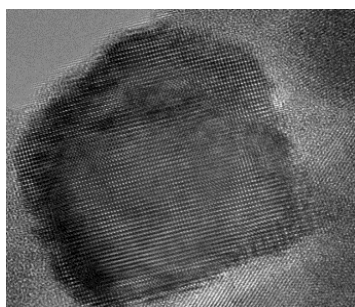


Figure 1. HRTEM picture of a Strontium Titanate nanoparticle synthesized in supercritical water/ethanol mixture

At the ICMCB, such complex oxides were already being produced, especially *via* supercritical synthesis in continuous flow. The first synthesis of $BaTiO_3$ (BT) with this method started in 2004 and has been followed by deep studies of the accessible solid solutions with the: i) A site, in this case barium with strontium (BST) and ii) B site, in this case titanium, with zirconium (BTZ). In both cases, whole solid solutions of these oxides were prepared, from BT to BST and BTZ. These syntheses were mainly achieved using alkoxide precursors. A drawback of these precursors, beside environmental context, is their poor stability. [4-5-6]

This communication will present a novel acetylacetonate precursor-based synthesis of high quality $SrTiO_3$ nanocrystals in supercritical flow conditions.

We will present the physicochemical characterizations of the produced particles with a focus on their thermal stability. These observations will be discussed using numerous characterization techniques such as X-ray diffraction, FTIR, Raman, ICP, and HRTEM. To summarize, using unusual precursors never used before to produce such type of particles in supercritical conditions (solvothetical synthesis), undiscovered physico-chemical properties were obtained.

References

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