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Supercritical Fluids Technology for Advanced Geominerals: from lab to pilot scale facilities

Cyril Aymonier[1*], Marie Claverie[1,2], Marta Diez-Garcia[1], François Martin[3], Christel Careme[2], Gilles Philippot[1], Michael Tsang[4], Guido Sonnemann[4]

[1] CNRS, Univ. Bordeaux, ICMCB, UPR 9048, F-33600 Pessac, France
[2] Imerys, Toulouse, France
[3] CNRS, Univ. Toulouse II, GET UMR 5563, F-31400 Toulouse, France
[4] Univ. Bordeaux, CNRS, ISM, UMR 5255, F-33400 Talence, France
*cyril.aymonier@icmcb.cnrs.fr

ABSTRACT

Supercritical fluids-based technologies are developed for more than 30 years, especially in the field of material processing from organics to inorganics through carbon-based materials [1]. This technology of material processing is continuous, fast (few tens of seconds), sustainable and scalable and gives access to high quality nanostructured materials with unique physico-chemical properties [2, 3], meaning which can not be obtained with other synthetic methods.

This presentation proposes to introduce first the tool box developed in the last ten years for *in situ* characterizations [1] developed to be able (i) to understand and model nucleation & growth of nanostructures in supercritical fluids [4] but also (ii) to control the synthesis of these nanostructures. After, we will present the first proof of the synthesis in few tens of seconds of geominerals, namely talc, in a continuous millifluidic process [3, 5]. Very interestingly, this synthetic talc exhibits unique properties as its hydrophilicity knowing that naturel talc is hydrophobic. In this new field of geomineral synthesis, we went one-step forward with the demonstration of the possibility to prepare highly crystalline geominerals in just few seconds again but under thermodynamically metastable conditions with the synthesis of the torbermorite mineral which is not abundant in nature but very interesting in the construction industry [6]. The mastering of the chemistry coupled with one pot multi-step processes opens the road towards the continuous design of multifunctional materials as illustrated with functional layer double hydroxide [7]. All these materials can now be produced from laboratory scale for research & development investigations to pilot scale for industrial purposes.

The benefits of the sub- and supercritical continuous hydrothermal route include not only better performances for advanced applications but also environmental issues associated with the synthesis process. This will be emphasized with the studies performed using LCA approaches [8] coupled with risk assessment ones [9].

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