



Contribution ID : 49

Type : Oral Presentation

Emulsions as a powerful tool to design silica monoliths able to selectively uptake radioactive caesium

Thursday, 2 November 2017 09:00 (15)

This work deals with the development of new templating routes to design porous nanostructured materials with innovative properties and/or easier to prepare. For example, we have shown that copper hexacyanoferrate nanoparticles could stabilize High-Internal Phase Emulsions or HIPE (**Mayer et al., J. Coll. Int. Sci., 2017, doi.org/10.1016/j.jcis.2017.05.113**) that can be used in a second step as a template for functionalized monoliths. It is of great interest considering that these coordination polymers come from Prussian blue analogues family, the most effective sorbent for caesium, and therefore relevant in nuclear decontamination purposes of ^{137}Cs or ^{134}Cs . To be active at oil/water interface and stabilize emulsions, CuHCF particles have to be modified with a polyelectrolyte, PDDA. The presence of CuHCF all around the oil droplets of the emulsions makes these particles located all around the macropores inside the final silica monolith due to the fact that the oil droplets are used as a template and should be therefore emptied after sol/gel gelification of the emulsions in order to create macropores. However, CuHCF can also be used without any PDDA surface modification. In this case, CuHCF nanoparticles are hydrophilic and remain in the water phase of the HIPE. The water outer part of the HIPE is the place where sol/gel reactions occur. Therefore, CuHCF nanoparticles are finally located in the monoliths walls if no PDDA is used. However CuHCF nanoparticles are still accessible to caesium in this case due to the mesoporosity of the walls because of the use of surfactant in this case to stabilize the HIPE (**Causse et al., J. Mater. Chem. A, 2014, 2, 9461**). And finally, we have also developed a third synthesis route of functionalized silica monoliths with CuHCF, CoHCF and ZnHCF. In this latter example, the HIPE is prepared only with the metal species, either Cu or Co or Zn. After the sol/gel reaction a meso/macroporous silica monoliths containing metal species is obtained. And finally after an impregnation step with $\text{K}_4[\text{Fe}(\text{CN})_6]$, the corresponding metal hexacyanoferrate particles precipitate inside the porosity of the silica monolith (**Sommer-Marquez et al., RSC Adv., 2016, 6, 73475**).

This global study showed that we can play with particles of interest in order to change their location in the templating soft matter (HIPE) and therefore inside the final monolith. Results of inorganic materials characterization (N_2 adsorption/desorption, SAXS, SEM, FTIR) as well as Cs sorption isotherms will be shown.

Summary

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Session Classification : Partitioning & Transmutation

Track Classification : National and international collaborative waste management programs