Cobalt(II)-Imidazolate Nanoparticles: aqueous synthesis and physicochemical characterization

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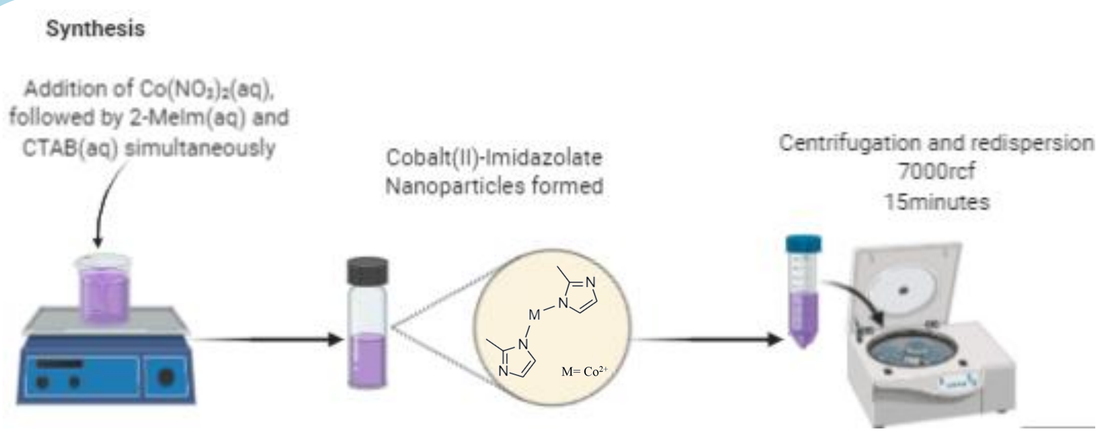
INTRODUCTION

Metal Organic Frameworks (MOFs) are an interesting class of crystalline coordination porous materials based on the coordination of metal centers with organic ligands. The correct selection of their components allows to adjust the pore size and morphology, resulting in materials that exhibit high surface areas. These physicochemical properties derived from their characteristic modular structures makes them ideal for use in applications such as catalysis, energy production and storage, sensors, pharmacological release, etc [1,2].

In this work, nanoporous metallic crystalline networks composed of Co^{2+} and 2-methylimidazole (2-MeIm) in different proportions were synthesized by means of a previously developed process [3] . The synthetic process is carried out in an aqueous medium at room temperature, which permits the control of the morphology, crystallinity and composition of porous nanoparticles (NPs).

The obtained NPs were structurally and physicochemically characterized by determining their size distributions, morphology and heat degradability. In addition, their colloidal stability and the associated size/morphological and compositional changes of the porous NPs in several solvents of different polarities were investigated, as well as the influence of the stabilizing surfactant (Cetyltrimethylammonium bromide, CTAB) used during the synthetic process.

MATERIALS AND METHODS



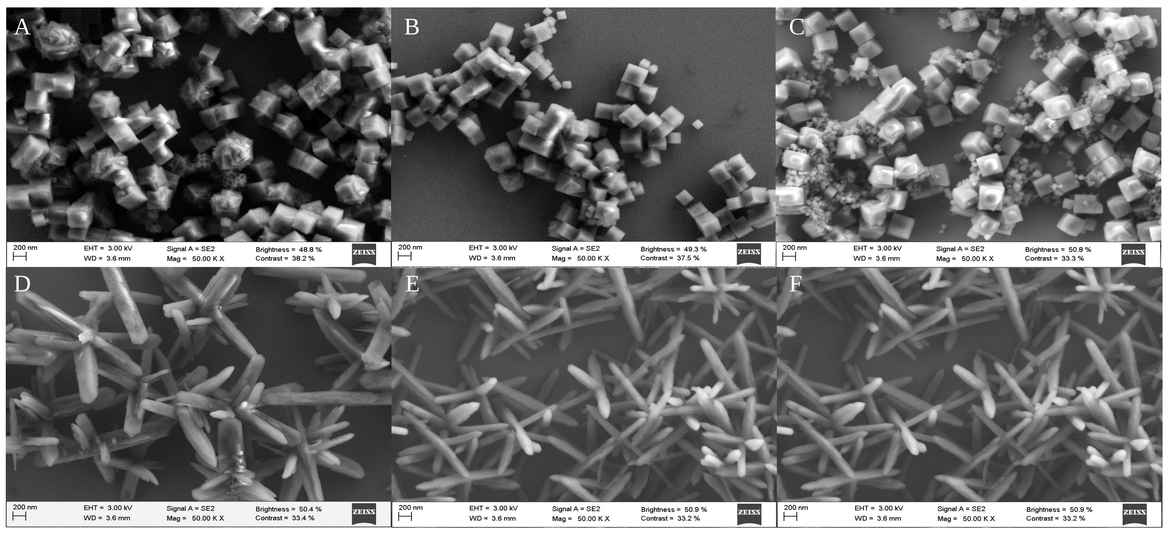
SYNTHESIS PARAMETERS

- Reaction time: 45 minutes
- Aqueous medium
- Room temperature
- Soft magnetic stirring

RESULTS

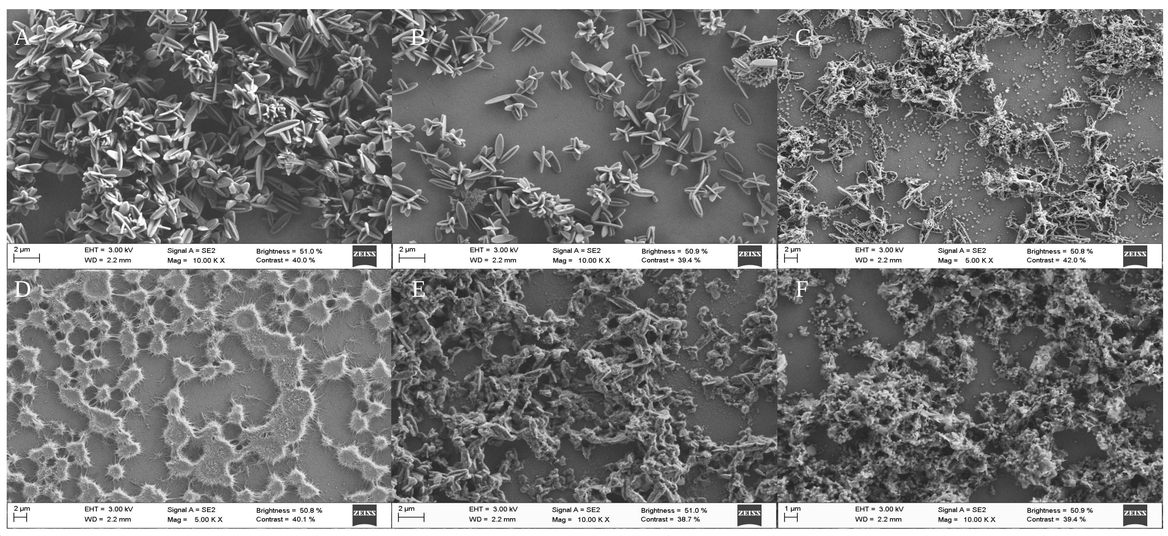
Cobalt(II)-Imidazolate Nanoparticles: effect of the molar ratio

STEM images of nanoparticles obtained under different molar ratio Co^{2+}:2MeIm:CTAB
a) 1:60:0,06 b) 1:50:0,05 c) 1:40:0,04 d) 1:20:0,02 e) 1:15:0,015 f) 1:10:0,01



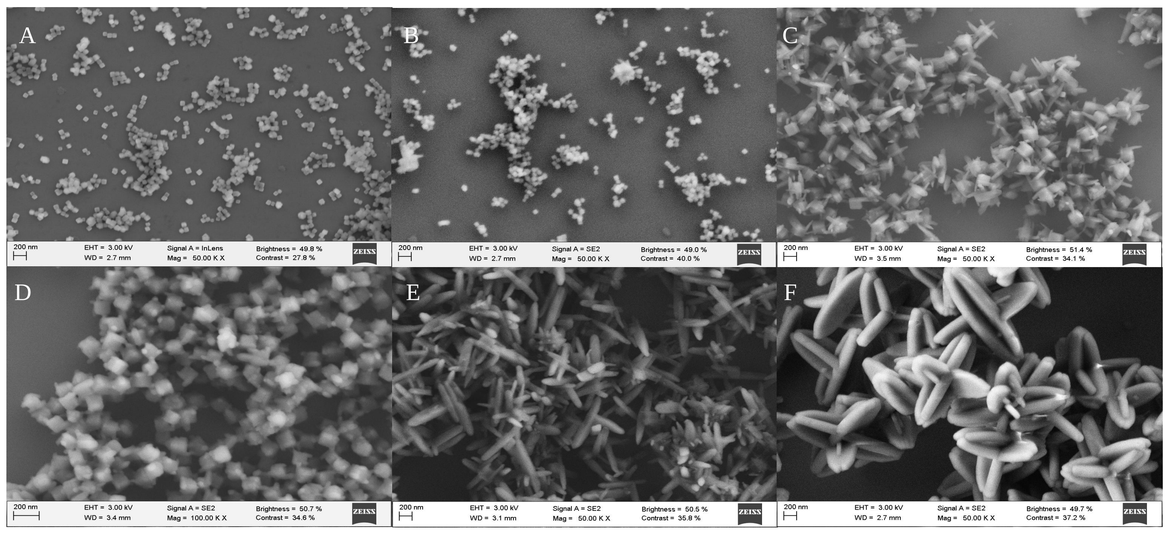
Cobalt(II)-Imidazolate Nanoparticles: effect of solvents with different polarities

STEM images of nanoparticles with a molar ratio Co^{2+}:2MI:CTAB = 1:20:0,02 obtained under several solvents of different polarities
a) ethyl acetate b)acetone c) N,N-dimethylformamide (DMF) d) acetonitrile e) methanol f) ultrapure water (Milli-Q water)

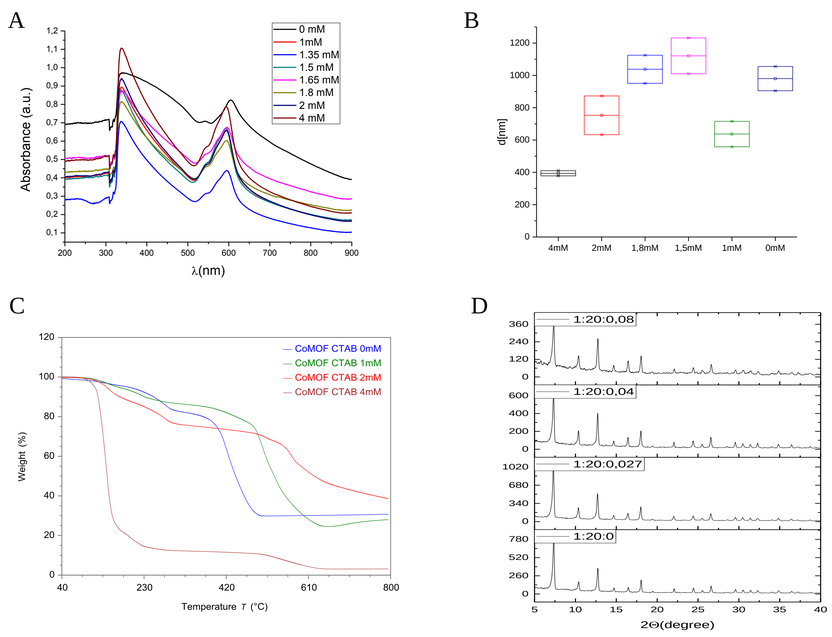


Cobalt(II)-Imidazolate Nanoparticles: constant concentration of surfactant

STEM images of nanoparticles obtained under different concentration of CTAB (Co^{2+}: 2MeIm = 1:20)
a) 4 mM b) 2 mM c) 1,8 mM e)1,5 mM f) 1 mM g) 0 mM



Colloidal characterization of the species: a) UV-Vis spectra b) mean average hydrodinamic diameter obtained from the DLS number distribution c) PXRD patterns d) TGA curves.



CONCLUSIONS

- The morphology of the porous nanoparticles is affected by the molar ratio of the constituent elements, the concentration of the surfactant and the solvent used in the synthetic process.
- As the molar ratio and the concentration of the surfactant decreases, the transition from a cubic structure to a structure in the form of a crossed spike is observed.
- The colloidal stability of the nanoparticles in different solvents was studied, being acetone the most suitable one because it does not affect the colloidal, chemical and structural integrity of the solids.
- PXRD shows the same cubic crystalline structure for the different morphologies obtained.
- TGA curves reveal that nanoparticles synthesized with a high concentration of CTAB exhibit a faster first weight loss.

REFERENCES

[1] Stock, N., Biswas, S. *Chem. Rev.*, **2011**, *112*, 933.

[2] Wang, L., Han, Y., Feng, X., Zhou, J., Qi, P., Wang, B. *Coord. Chem. Rev.* **2016,** 307, 361.

[3] Navarro Poupard, M., Polo, E., Taboada, P., Arenas-Vivo, A., Horcajada, P., Pelaz, B., del Pino, P. *Inorg. Chem.* **2018,** *57*, 12056.

ACKNOWLEDGEMENTS

This work was supported by Agencia Estatal de Investigación (AEI) through Project MAT2016-80266-R, and Xunta de Galicia (Grupo de Referencia Competitiva ED431C 2018/26; Agrupación Estratégica en Materiales-AEMAT ED431E 2018/08). FEDER funds are also acknowledged.