Poster

Clickable Zr-based MOFs as versatile multifunctional nanoplatforms for biomedical applications

Visiga Hernández, Ana María (1), Carrillo Carrión, Carolina (1), Khiar, Noureddine(1)

(1)Asymmetric Synthesis and Functional Nanosystems Group. Institute of Chemical Research, CSIC. C/ Américo Vespucio,49,41092,Seville, Spain.

Tutor académico: Merkling, Patrick Jacques

Keywords: NanoMOFs; UiO66; cancer

ABSTRACT

Motivation: Cancer is a group of diseases characterized by uncontrolled cell growth. It is among the leading causes of mortality in the world, which is why anti-tumor therapies have been developed, such as chemotherapy, radiotherapy and surgery. Although tumor growth can be decreased by these treatments, they can also damage normal cells and organs [1]. In order to improve the selectivity of these treatments, several new targeted drug therapies using new nanomaterials as carriers to deliver drugs only into tumor areas are being developed [2]. It has been found that Nanosized-MOFs are among the best candidates due to their high drug-loading ability and tunable porosity and structure. These nanoparticles are composed of different metal ions and organic ligands that form an extended crystalline network [3]. In this study, nanosized UiO-66 have been functionalized with new targeting ligands giving rise to a promising multifunctional nanoplatforms for different biomedical applications

Methods: Within this project, N_3-$(PEG)_5$-PO_3 and N_3-$(PEG)_{20}$-PO_3 have been synthesized and used as ligand for the external surface functionalization of nanoUiO-66 to improve the stability of the nanoconstructs in cellular environments to enhance and delay drug-released capability [3]. These two coatings have been synthesized to unravel which one stabilizes nano-UiO66 over the time and under biological setting. Later, a copper free click reaction using DBCO-dye demostrated that azide was accessible. In addition, doxorubicin, an anti-tumoral drug, has been introduced into the funcionalized nano UiO-66 particles to evaluate the loading efficiency of the as-prepared system.

Results: The structure of N_3-$(PEG)_5$-PO_3 and N_3-$(PEG)_{20}$-PO_3 have been determined by ^{1}HNMR, ^{13}CNMR and high- resolution mass spectroscopy. On the other hand, nanoUiO-66 properties such as size, morphology and porosity have been studied by using Dynamic Light Scattering (DLS), Scanning Electron Microscopy (SEM), Powder X-ray Diffraction (XRD) and N2 isotherms. Finally, functionalization have been confirmed by Zeta-potential, FT-IR and NMR.

Conclusions: The main achievement of this project has been to synthesize nano-UiO66 and functionalize it with ligands. It was first demonstrated that phosphate improved colloidal stability in arqueous media [3]. Secondly, nanosizedUiO66 stability in aqueous medium was improved thanks to N_3-$(PEG)_{20}$-PO_3. Finally, a multifunctional nanoplatform was obtained by means of Click Chemistry.

REFERENCES

1. Junlei Y.;Hui W.; Jinyao L.; Mengkui D.;Xianjin X.; Xiaoyu Y.;Shuang Z.;Ruizhouo O.; Yuqing M. (2020). Recent advances in nanosized metal organic frameworks for drug delivery a tumor therapy..RSC Adv,11, 3241-3263
2. Jintong L.; Jing H; Lei, L: Jianping L,.(2021). Multifunctional metal-organic framework heterostructures for enhanced cancer therapy. Chem. Soc. Rev.,50,1188-1218
3. X. Chen, Y. Zhuang, N. Rampal, R. Hewitt, G. Divinitini, C. A. O´Keefe, X. Liu, D. J. Whitaker, J. W. Wills, R. Jugdaohsingh, J. J. Powell, Han Yu, C. P. Grey, O. A. Scherman & D. Fairen-Jimenez (2021). Formulation of Metal-Organic Frameworks-Based Drug Carriers by Controlled Coordination of Methoxy PEG Phosphate: Boosting Colloidal Stability and Redispersibility. J. Am. Chem. Soc., 143(34), 13557–13572