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Influence of amino acid ionic liquids on morphology and sorption properties of HKUST-1

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Metal-organic frameworks (MOFs) are a type of unique structures characterized by very large surface area, reaching even 6000 m^2/g. Thanks to that, MOFs could be useful in wide variety of applications like photocatalytic degradation of pollutants, hydrogen generation, drug delivery or as innovative and more effective in comparison to the commonly used materials – gas sorbents. The highly-porous MOF consisting of copper nodes and tritopic linker – 1,3,5-benzenetricarboxylic acid – known as HKUST-1, Cu-BTC or MOF-199, shows the carbon dioxide sorption capacity at remarkable level of 4.38 mmol/g. The influence of bio-based amino acid ionic liquid (AAIL), possessing high affinity towards CO_2, on MOFs morphology and sorption properties was investigated. Four AAILs (two 1-butyl-3-methylimidazolium- [BMIM] and two 1-ethyl-3-methylimidazolium-based [EMIM]) and one commercial ionic liquid used as reference (1-butyl-3-methylimidazolium bromide) were utilized to modify the chosen MOF. Two approaches of ionic liquid introduction were utilized, namely synthetical incorporation and post-synthetical impregnation. To validate the influence of AAILs on HKUST-1, techniques like Powder X-ray Diffraction and Fourier Transform Infrared Spectroscopy were used. Scanning Electron Microscopy was utilized to reveal the morphology of products. Size of the surface area was determined using Brauner-Emmett-Teller isotherm. Volumetric method was utilized to determine the adsorption capacity for CO_2. Sorption capacity at 25 °C for CO_2, CH_4 and N_2 was investigated within the pressure range of 0.5-10 bar with gravimetric unit. Incorporation of L-proline-based ionic liquid to the synthesis environment of HKUST-1 increased value of carbon dioxide sorption capacity reaching 6.26 mmol/g, giving 43% increase in comparison with pristine sample. Therefore, the selection of appropriate AAIL, as well as the method of introduction can lead to the improvement of sorption capacity and preservation of crystal structure of MOF.