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Hydrogen storage in HKUST-1@Activated Carbon composites obtained by Resonant Acoustic Mixing

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Metal-organic frameworks (MOFs) are promising adsorbents for hydrogen storage, as they feature adaptable porosities, high surface areas and the potential to be functionalized to suit specific applications [1]. Incorporating carbon materials into the MOF matrix has already proved to be a successful strategy for enhancing the specific surface area of the resulting composite material compared with the original MOF. This, in turn, improves its adsorption capacity [2]. This study focuses on the impact of mixing a commercial, high-surface area activated carbon (AC, MSC 30 from Kansai Coke and Chemicals Co., Ltd.) with a well-known MOF, HKUST-1, on the properties of the composite, including hydrogen storage capacity. Resonant Acoustic Mixing (RAM) was used because it provides exceptional powder mixing. Figure 1 shows a schematic representation of the synthesis method and some relevant results.

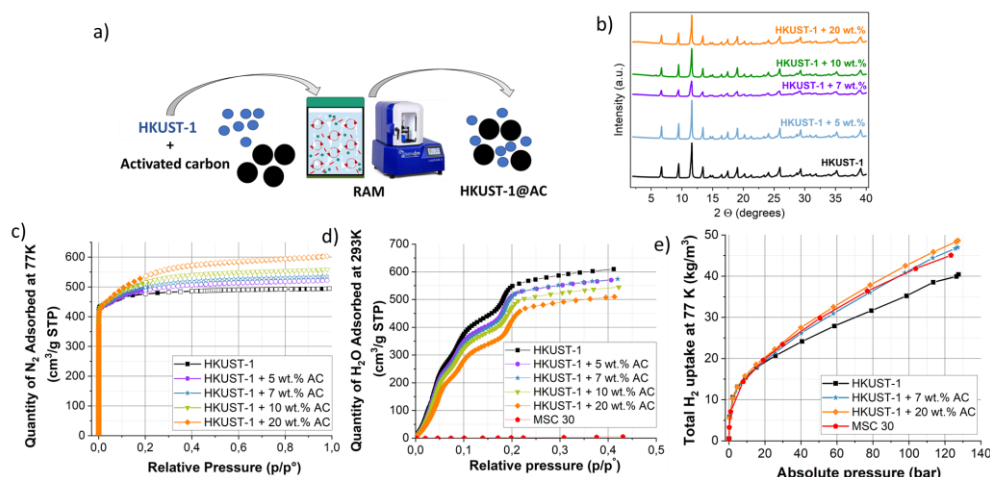


Figure 1 a) Schematic representation of the synthesis process. For commercial HKUST-1 and its composites: b) XRD patterns; c) N₂ isotherms at 77 K; d) Amount of H₂O adsorbed at 293 K; e) Total H₂ uptake (kg/m³)

Mixing different weight percents of AC with HKUST-1 increased the mesopore volume, leading to enhanced H₂ uptake at pressures above 20 bars, and the composites exhibited reduced hydrophilic behavior, possibly extending their lifespan. The total H₂ uptake increased from 40.4 kg/m³ for pure HKUST-1 to 48.6 kg/m³ for the composite with 20 wt.% AC, surpassing the H₂ storage capacity of pure AC, 45.07 kg/m³ at 130 bar and 77K.

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