



**HAL**  
open science

# Utilizing Resonant Acoustic Mixing to Combine HKUST-1 with Activated Carbon for Hydrogen Adsorption Applications

Laura Jimenez-Lopez, Rafael Augusto MORALES OSPINO, Jimena Castro-Gutiérrez, A. Celzard, Vanessa Fierro

► **To cite this version:**

Laura Jimenez-Lopez, Rafael Augusto MORALES OSPINO, Jimena Castro-Gutiérrez, A. Celzard, Vanessa Fierro. Utilizing Resonant Acoustic Mixing to Combine HKUST-1 with Activated Carbon for Hydrogen Adsorption Applications. 13èmes journées de l'Association Française d'Adsorption (AFA), Feb 2024, Caen, France. hal-04568150

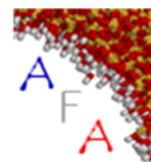
**HAL Id: hal-04568150**

**<https://hal.univ-lorraine.fr/hal-04568150>**

Submitted on 3 May 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



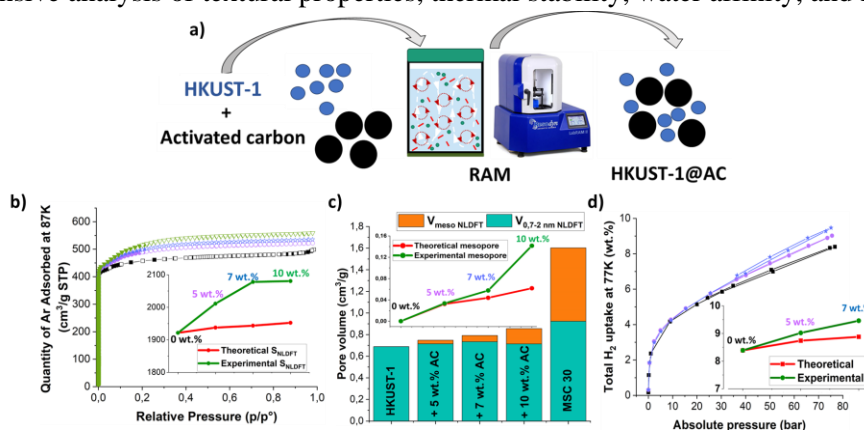
## Utilizing Resonant Acoustic Mixing to Combine HKUST-1 with Activated Carbon for Hydrogen Adsorption Applications

Laura Jimenez-Lopez<sup>a</sup>, Rafael Morales<sup>a</sup>, Jimena Castro-Gutierrez<sup>a</sup>, Alain Celzard<sup>a,b</sup>,  
Vanessa Fierro<sup>1</sup>

<sup>a</sup> Institut Jean Lamour, Université de Lorraine, Epinal, France

<sup>b</sup> Institut Universitaire de France (IUF)

Metal-organic frameworks (MOFs) have emerged as highly promising candidates for hydrogen storage due to their adaptable porosity, large surface area, and the possibility to functionalize them for particular applications [1]. Incorporating carbon-based materials into the MOF matrix has proven effective in increasing specific surface area of the resulting composite material, thereby enhancing its adsorption capacity [2]. This study focuses on assessing the impact of introducing a commercial activated carbon (AC, MSC 30 from Kansai Coke and Chemicals Co., Ltd.) into the HKUST-1 matrix. This assessment involves comprehensive analysis of textural properties, thermal stability, water affinity, and H<sub>2</sub> uptake.



**Fig. 1.** a) Schematic representation of the synthesis process; b) Ar isotherms at 87K and, theoretical vs experimental  $S_{NLDFT}$  (insert); c) Pore volumes and, theoretical vs experimental mesopore volume (insert); d) Total H<sub>2</sub> uptake at 77K and theoretical vs experimental total H<sub>2</sub> uptakes (insert)

Incorporating varying weight percentages of AC into HKUST-1 enhanced the textural characteristics of the resultant composite materials by increasing the mesopore volume. The total H<sub>2</sub> uptake increased by 3.7% and 6.8% with the addition of 5 and 7 wt.%, respectively, of AC, surpassing the theoretical H<sub>2</sub> capacities. These theoretical capacities were calculated by considering the mass percentages of HKUST-1 and AC, assuming a linear additive effect. The heightened H<sub>2</sub> uptake is ascribed to the higher mesopore volume in the composites.

#### Acknowledgments:

The projects TALISMAN and TALISMAN2, financed by the European Regional Development Fund (ERDF) and the project PEPRH2-SOLHYD (ANR-22-PEHY-0007) financed by the French Research Agency (ANR) are gratefully acknowledged

#### Références:

- [1] S. Bordiga et al., 'Adsorption properties of HKUST-1 toward hydrogen and other small molecules monitored by IR', *Phys. Chem. Chem. Phys.*, vol. 9, no. 21, pp. 2676–2685, May 2007, doi: 10.1039/B703643D.
- [2] A. Policicchio et al., 'Enhancing the gas adsorption capacities of UiO-66 by nanographite addition', *Microporous and Mesoporous Materials*, vol. 309, p. 110571, Dec. 2020, doi: 10.1016/j.micromeso.2020.110571.