

Supporting Information

Gas phase synthesis and adsorption properties of a 3D ZIF-8 CNT composite

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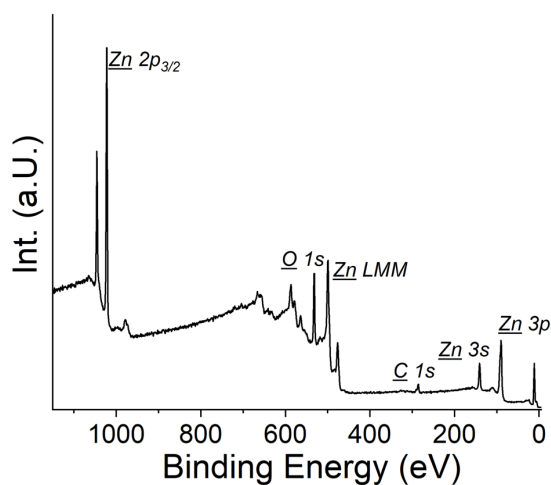


Figure S1 XPS Survey Spectra of the ZnO@VACNT composite

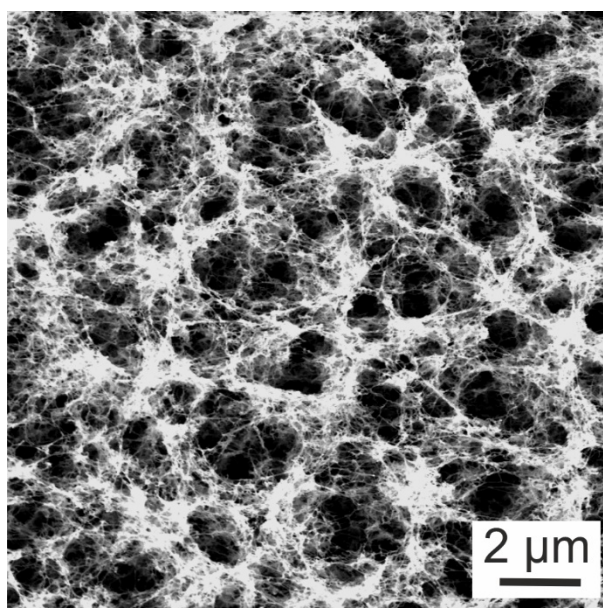


Figure S2 HREM image of the ZnO@VACNT surface showing the dense ZnO coverage of the VACNTs with strong surface charging effect

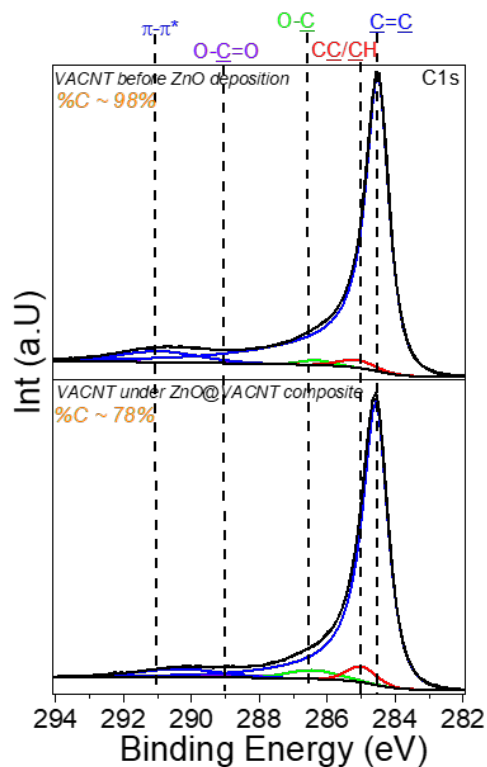


Figure S3 C1s spectra of VACNT layers before ZnO deposition and after mechanic removal of most of the ZnO@VACNT composite.

The C1s signal detected from the surface after removal of most of the composite is very similar to that observed on the pristine VACNT layer (Fig. S3). Indeed, Carbon spectra show in Fig. S3 are composed by five peaks, which mainly correspond to carbon from VACNT. The main peak at 284.5 eV (blue component) corresponds to the C=C environment. Asymmetric shape of this peak is the signature of a Sp^2 -type carbon, confirming the 3D structure of the VACNT.^[1,2] The weak peak at 285 eV corresponds to a hydrocarbon contamination (C-C/C-H). The green peak at 286.5 eV is assigned to O-C environment and the violet peak at 289 eV corresponds to O-C=O environment. Another peak (blue component) at around 291 eV is attributed to π - π^* shake-up. Satellite corresponds to excitation of the π - π^* transition by the outgoing photoelectron from unsaturated carbon of C=C double bond. The peak with asymmetry shape and satellite (π - π^* transition) are the signature of carbon from VACNT.

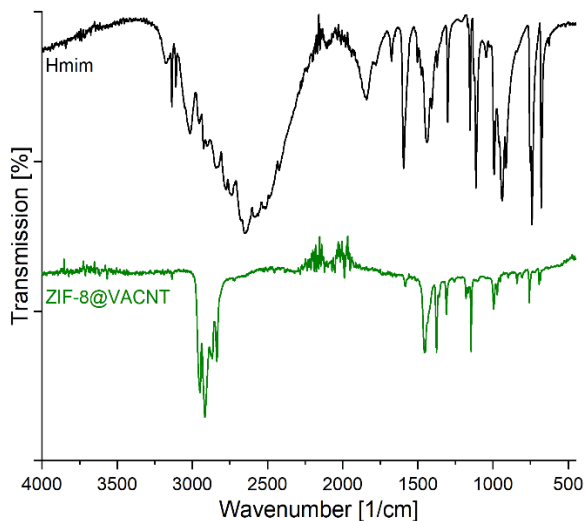


Figure S4 ATIR spectra of Hmim (black trace) and the ZIF-8@VACNT composite (green trace).

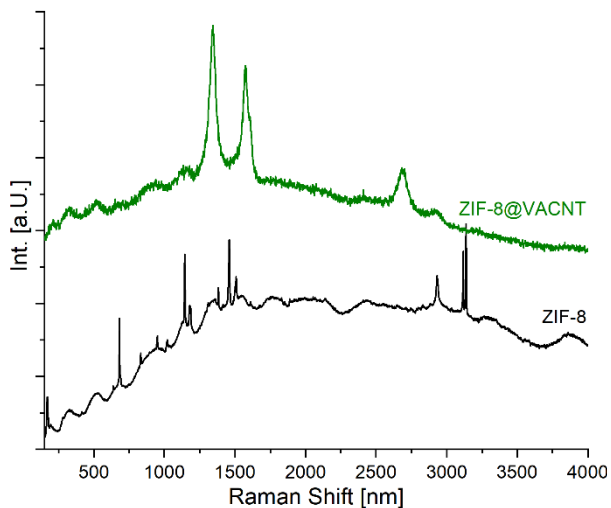


Figure S5 Raman spectra of ZIF-8 (black trace) and the ZIF-8@VACNT composite (green trace).

IR characterisation of the ZIF-8@VACNT composite (Figure S4) reveals the typical ZIF-8 pattern as reported.^[3] In contrast to the free ligand (black trace) the ZIF-8 spectra (green trace) shows no N-H stretching vibration characteristic for ZIF-8 formation.

The Raman spectra (Figure S5) of the composite shows traces of the ZIF-8 component. In comparison to pristine VACNTs the intensity of the D band is significantly increased compared to the G band. This can be assigned to the intense coverage of the VACNT host structure with the ZIF-8 film.

- [1] A. Theodosiou, B. F. Spencer, J. Counsell, A. N. Jones, *Applied Surface Science* **2020**, 508, 144764.
- [2] Yu. V. Butenko, S. Krishnamurthy, A. K. Chakraborty, V. L. Kuznetsov, V. R. Dhanak, M. R. C. Hunt, L. ifmmode \checkS\else Š\filler, *Phys. Rev. B* **2005**, 71, 075420.
- [3] P. Arabkhani, H. Javadian, A. Asfaram, M. Ateia, *Chemosphere* **2021**, 271, 129610.