Metal Oxide Foams for Pharmaceutical Amorphization

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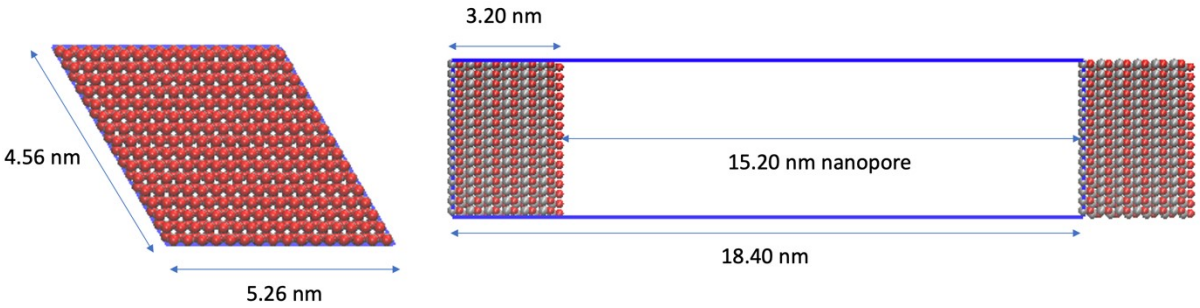
Supplementary Information

S1 Micropore size distribution estimation

Theories of Brunauer–Emmett–Teller (BET) and Barrett-Joyner-Halenda (BJH) are well-known approaches for determining the pore size distribution of micro- and mesoporous materials with pores in the range of 2 to 50 nm. The method can determine pore volume as a function of pore diameter from adsorption-desorption isotherms. From this approach, the size of the estimated micropores was 4 nm for the ZnO foams.

S2 Construction of the ZnO slab and nanopore simulation cell details and system compositions

A ZnO slab of 6144 atoms with lengths of 5.26 nm in the *x*-axis, 4.56 nm in the *y*-axis and 3.20 nm in the *z*-axis, was generated with Avogadro v1.2.0, using the lattice parameters *a*: 3.28910 Å, *b*: 3.28910 Å, *c*: 5.30682, α: 90º, β: 90º and γ: 120º. The periodic boundary conditions of the simulation cell were used to create a nanopore of 15.20 nm with a total simulation cell length of 18.40 nm in the *z*-axis.



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The composition of the simulated fluid is 300 PCM, 100 MCM, 1000 isopropanol and 6372 water molecules. The simulation parameters of both APIs and the solvent were already described in previous works.[1]

S3 Manufacturing of non-porous ZnO structure

Structural tests were included to assess the stability of the amorphous foam solid samples; the samples were characterized via PXRD after 200 days.

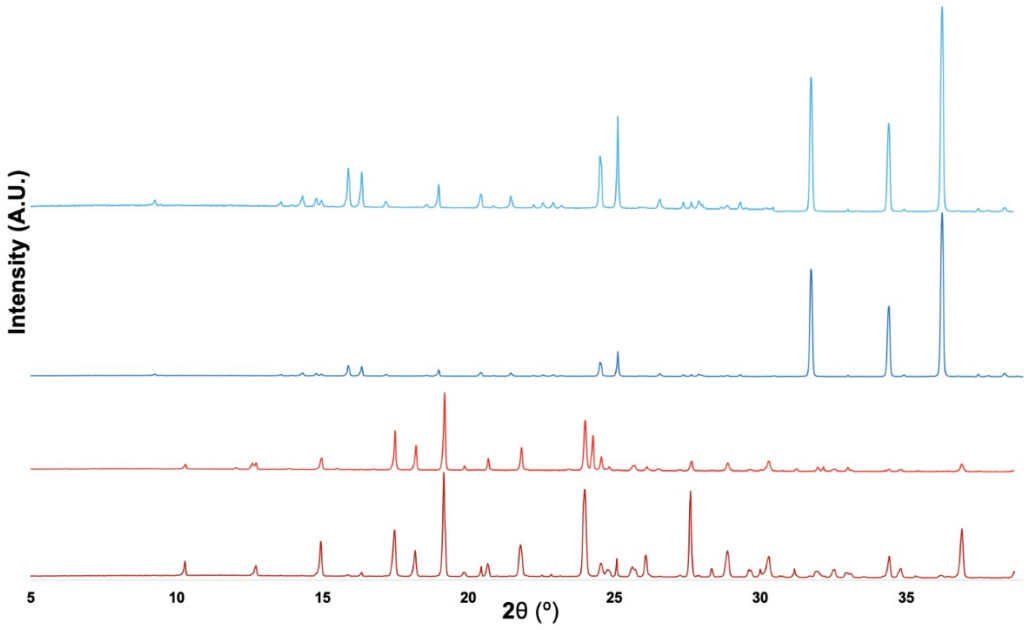

Figure S1. PXRD patterns of foam solids (dark blue) and foam solids 200 days after synthesis (light blue), and beaker solids (dark red) and beaker solids 200 days after synthesis (light red).

S4 Manufacturing of non-porous ZnO structure

The non-porous ZnO structure used as the control was prepared from the same dispersion used for the porous foams. After the addition of the crosslinker to the PVA, CTAB and ZnO particles dispersion, the mixture was placed into the oven (80 °C for 80 min) for solvent evaporation with subsequent drying (10 h at 50 °C). The solid material was sintered at 900 °C for 12 h.

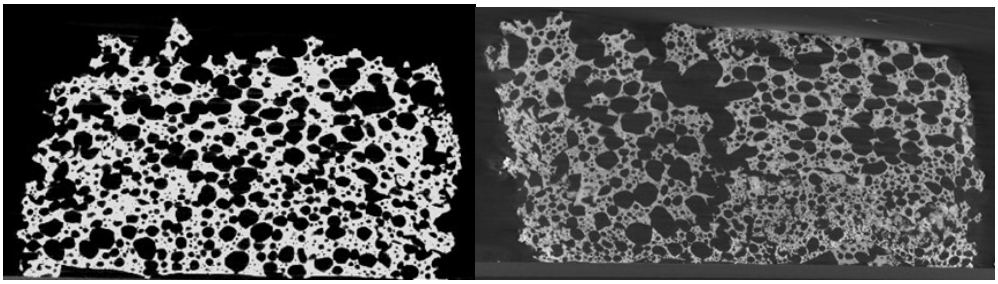

Figure S2. Micro CT lateral slice view for determination of macropore size distribution.

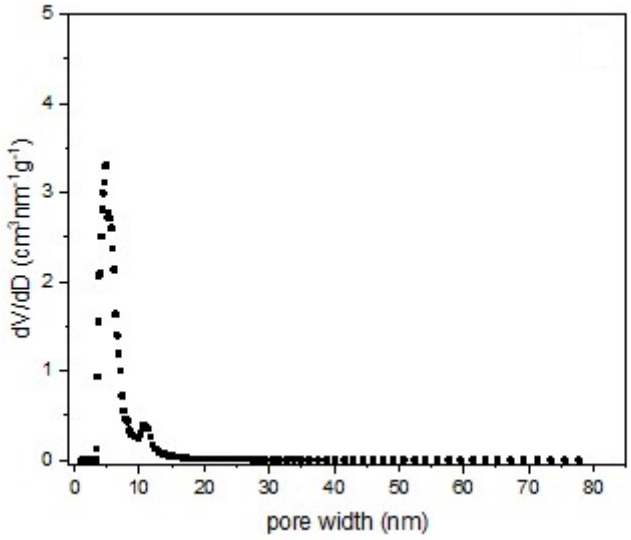

Figure S3. BJH characterization of the ZnO foam for determination of micropore size, BET characterizations of the ZnO foam can be found in a previous study from Thais et al.[2]

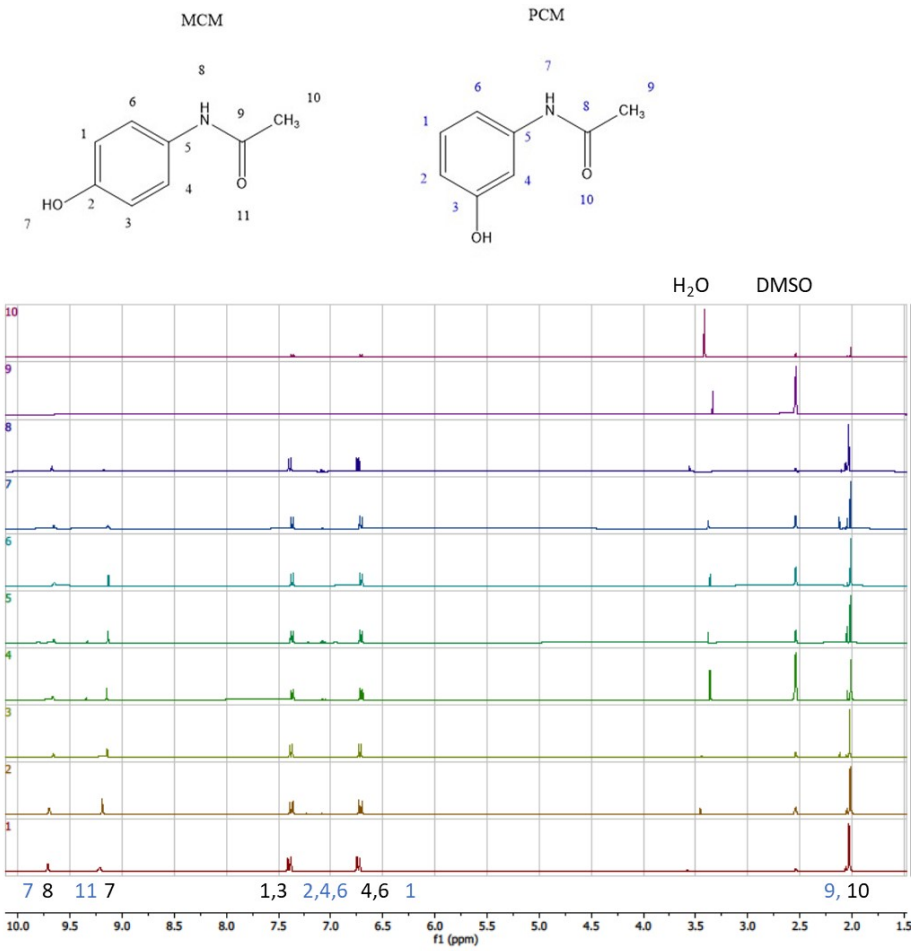

Figure S4. The ^{1}H NMR spectrum of the paracetamol (PCM) and metacetamol (MCM) co-crystals ratio formed within the foam`s pores and beaker (samples label: 1- foam 1 edge; 2- foam 1 beaker; 3- foam 2 edge; 4- foam 2 inner; 5- foam 2 beaker; 6- foam 3 edge; 7- foam 3 inner; 8- foam 3 beaker; 9- control egde/inner and 10- control beaker.)

Table S1. ZnO energy landscape of the API solution in pore

Energy	**kJ/mol**	**Error**
Potential	-81.641	0.006
Kinetic	6.9385	0.0001
Total	-74.702	0.006
Zn-Fluid	-0.286	0.001
O-Fluid	-0.293	0.002

Table S2. ZnO energy landscape of the APIs in pore

Energy	kJ/mol	Error
Potential	-53.83	0.04
Kinetic	2.97913	0.00005
Total	-50.85	0.04
Zn-Fluid	-0.111	0.003
O-Fluid	-0.114	0.003

References

(1) Al-Ani, A. J.; Herdes, C.; Wilson, C. C.; Castro-Dominguez, B. Engineering a New Access Route to Metastable Polymorphs with Electrical Confinement. *Cryst. Growth Des.* **2020**, *20* (3), 1451–1457.

(2) Tasso Guaraldo, T.; Wenk, J.; Mattia, D. Photocatalytic ZnO Foams for Micropollutant Degradation. *Adv. Sustain. Syst.* **2021**, *5* (5), 2000208.