

Direct access to primary amines and particle morphology control in nanoporous CO₂ sorbents

N. A. Dogan¹, E. Ozdemir¹, C. T. Yavuz^{1,2*}

¹Graduate School of EEWS, ²Department of Chemistry

Chemical tuning of nanoporous, solid sorbents for an ideal CO₂ binding requires unhindered amine functional groups on the pore walls. Although common for soluble organics, post-synthetic reduction of nitriles in porous networks often fail due to the insufficient and irreversible metal hydride penetration. Here, we synthesized a nanoporous network with pendant nitrile groups, microsphere morphology and in large scale. The hollow microspheres were easily decorated with primary amines through in situ reduction by widely available boranes. CO₂ capture capacity of the modified sorbent was increased up to four times of the starting nanoporous network with a high heat of adsorption (98 kJ/mol). Surface area can be easily tuned between 1 and 354 m²/g. Average particle size (~50 μm) is also quite suitable for CO₂ capture applications where processes like fluidized bed require spheres of micron sizes.

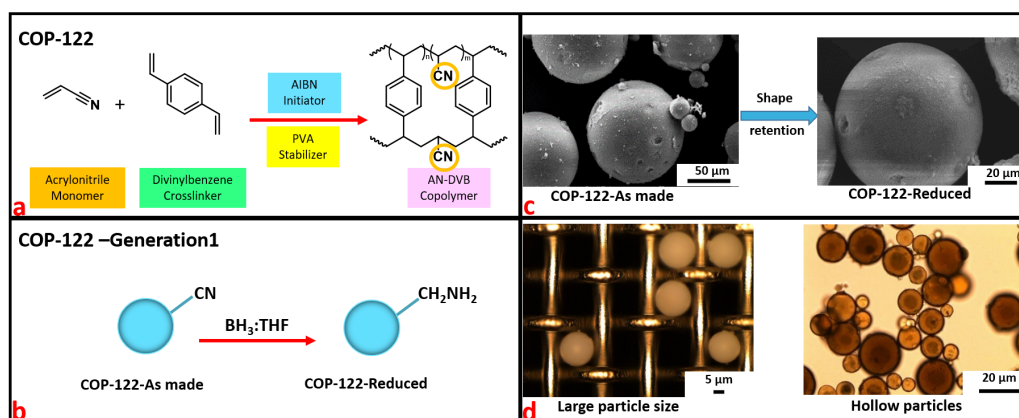


Figure 1. (a) Synthesis of acrylonitrile-divinylbenzene copolymer (COP-122) by suspension polymerization. The resulting nanoporous network polymer has the shape of spherical beads with dangling -CN groups spread out inside each polymer particle (b) Synthetic pathway to reduce nitrile groups on COP-122. After reduction, amine groups are obtained on polymer surface and inside the pores (named as COP-122-Generation1). (c) SEM picture of a single polymer particle surrounded by other particles. Morphology of COP-122-Generation1 is retained after reduction. (d) Optical microscope image of COP-122 particles. Large particle size of COP-122 makes it suitable for industrial applications.

[1] Nesibe A Dogan, Ercan Ozdemir, Cafer T Yavuz, ChemSusChem, 2017, doi:10.1002/cssc.201700190