Porous Liquids and
Solvent-free Continuous Manufacture of MOFs by Mechanochemistry

Stuart James

School of Chemistry and Chemical Engineering, Queen's University Belfast, David Keir Building, Stranmillis Road, Belfast BT9 5AG, United Kingdom
s.james@qub.ac.uk

Abstract

Porous Liquids: Porosity is a fundamentally important property of materials, but is normally only associated with the solid state. Porous solids (such as zeolites and PCPs/MOFs) have many useful properties such as selective gas absorption, but their solid nature imposes limitations. For example, they are difficult to implement in continuous flow technologies and cannot be used as solvents for chemical reactions.

We have recently invented the first porous liquids (PLs) – i.e. liquids containing permanent, empty micropores. The presence of empty pores greatly increases the solubility of gases in the liquid, and the pores can selectively enhance the solubility of one gas over another. We have also found that PLs can be prepared easily and cheaply which will accelerate their industrial implementation.

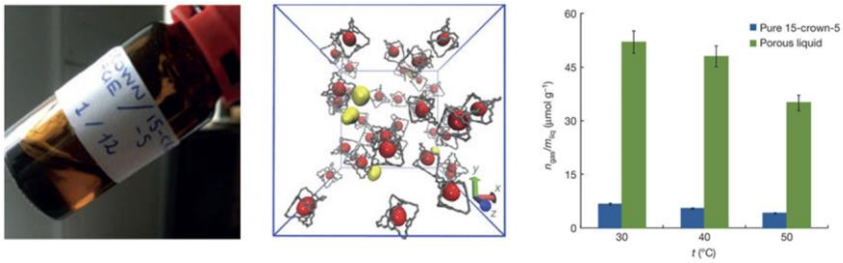

Figure1. An example of a porous liquid, modeling of the liquid state and increased methane solubility.

Solvent-free, continuous manufacture of MOFs by mechanochemistry: A major impediment to the commercial application of MOFs has been their economic scalable manufacture. To solve this problem, we have shown that MOFs (and other materials) can be manufactured economically, using little or no solvent, by vigorously grinding together solid reactants. (mechanochemistry). Advances in fundamental knowledge of how mechanochemical reactions progress, as well as the development of this technique into continuous scalable manufacturing methods by Twin Screw Extrusion (Figure 2) will be presented.

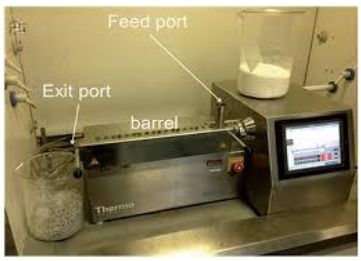

Figure 2. A twin-screw extruder used for scalable solvent-free production of MOFs and other materials.

References:

1. N. Giri et al. *Nature*. 2015, 527, 216; doi:10.1038/nature16072.
2. D. Crawford et al. *Chem. Sci.* 2015, **6**, 1645; B. Hutchings et al. *Angew Chem. Int. Ed*. 2017, DOI**:** 10.1002/anie.201706723.