4th International Symposium on
Energy Challenges & Mechanics
- working on small scales

11-13 August 2015
Aberdeen, Scotland, UK

Hypercrosslinked Microporous Organic Polymers for Hydrogen Storage

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Accepted for publication on 12th April 2015

Hydrogen is considered as an ideal green clean energy which can replace the use of fossil fuel in the future. However, the widespread use of hydrogen as a fuel is limited because of the lack of a convenient, safe, and cost-effective method of hydrogen storage. Storage by physisorption via microporous materials is a promising method because of the high adsorption rate and reversible process in which the materials are exacting demanded with excellent performance. Hypercrosslinked microporous organic polymers have attracted enormous attention due to a number of potential advantages including large surface area, light weight property, diverse synthetic routes and most important that they are low-cost materials which are scalable in real industrial production. Hypercrosslinked microporous materials as efficient hydrogen adsorbents have been investigated for years and some progress has already been made.

Hypercorsslinked networks based on the self-polycondensation of functional monomer were successfully synthesized with very high surface which also exhibited a relatedly high gravimetric storage capacity of 3.68 wt % at 15 bar and 77.3 K. (Wood C. and Tan B. *et al: Chem. Mater*. **2007**, *19*, 2034) Otherwise, uniform nanoparticles were obtained by emulsion polymerization to reduce the balance time caused by the long diffusion path in bulk polydisperse micro-size “Davankov Resins”. The hypercorsslinked microporous nanoparticles present a higher hydrogen adsorption capacity (1.59 wt %), higher hydrogen adsorption isosteric heats and faster adsorption rate. (Tan B.* *et al: J. Mater. Chem.* **2010**, *20*, 7444) Furthermore, catalyzed hydrogen spillover was studied via a hypercrosslinked polymers containing 2 wt % Pt nanoparticles. Compared to the similar materials without Pt nanoparticles, the hydrogen adsorption amount has been enhanced by a factor of 1.75. (Tan B.* *et al: Int. J. Hydrogen energy* **2012**, *37*, 12813) Porous polyimides (Tan B.* *et al: Chem. Commun.* **2011**, *47*, 7704) and organic-inorganic hybrid porous materials (Tan B.* *et al*: *J. Mater. Chem. A*, **2015**, *3*, 6542) were also investigated as hydrogen adsorbents with comparable performance.

Keywords: hydrogen storage, microporous, hypercrosslinked polymer, low-cost

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超交联微孔聚合物储氢应用

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2015 年 4 月 13 日接受发表

氢能被认为是一种未来能够取代化石燃料的理想绿色清洁能源。然而作为一种新型能源，氢气的大规模使用仍然受到限制，原因在于缺乏一种便捷、安全且成本低廉的储存方式。通过微孔材料物理吸附的方式进行储存是一种非常有潜力的方法，它的优点在于高吸附速率和可逆的释放过程，但是要求材料具有非常优良的性能。超交联微孔有机聚合物由于具有高比表面积、质轻、合成方法多样等优点，引起人们的广泛关注，更重要的是这类材料的合成比较廉价，能够被大规模工业化生产。超交联微孔聚合物作为有效的储氢材料已经被研究多年并且取得了令人瞩目的进展。

我们通过功能化小分子自缩聚得到的超交联网络具有非常高的比表面积并且在 15 bar/77 K 条件下显示出 3.68 wt %极高氢气吸附量。(Wood C. and Tan B. *et al: Chem. Mater.* **2007**, *19*, 2034) 另外，我们研究发现通过乳液聚合制备得到尺寸均一的超交联微孔纳米颗粒，能够通过缩短氢气扩散路径减少吸附的平衡时间，因此具有更高的氢气吸附量、吸附热以及更快的吸附速率。(Tan B.* *et al: J. Mater. Chem.* **2010**, *20*, 7444) 进一步，我们研究了含有 2 wt %铂纳米颗粒超交联聚合物的氢溢流现象。相比于没有铂纳米颗粒的材料，这类掺杂了金属的材料的氢气吸附量被提高了 1.75 倍。(Tan B.* *et al: Int. J. Hydrogen energy* **2012**, *37*, 12813) 其他类型的微孔聚合物材料，如多孔聚酰亚胺(Tan B.* *et al: Chem. Commun.* **2011**, *47*, 7704)以及有机无机杂化材料(Tan B.* *et al*: *J. Mater. Chem. A*, **2015**, *3*, 6542)也能够显示出良好的氢气吸附性能，作为有效的储氢材料。

关键词：储氢，微孔，超交联聚合物，廉价