

# Palladium-doped Carbon Porous Materials as Adsorbents for Hydrogen Storage

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Hydrogen has been recognized as an ideal energy carrier because it is clean and easy to produce from renewable energy sources. In the past several decades, efficient hydrogen storage and transport devices have been the major concerns in hydrogen-energy technology. H<sub>2</sub> storage schemes in terms of compressed or liquefied gas are undesirable due to low storage density and high cost. Recently, carbon porous materials (CPMs) with well-defined pore structures offered great potential as adsorbents for H<sub>2</sub> storage. Several existing literature reports revealed that, when doped with transitional-metals (such as Pt, Pd, Ni etc.), carbon-based adsorbents exhibit enhanced H<sub>2</sub> uptake due to spillover effect. This study aims to compare the effects of doping palladium (Pd) on H<sub>2</sub> storage properties of various carbon materials, including ordered mesoporous carbons such as FDU-15, CMK-3, and CMK-5, as well as activated carbon (AC) and activated carbon fiber (ACF). Two metal doping routes, namely post-synthesis impregnation and one-pot synthesis methods were implemented and compared. Typically, carbon adsorbents so synthesized with varied Pd loadings were first subject to evacuation treatment prior to H<sub>2</sub> uptake measurement (pressure: 7 bar; RT). Our preliminary results show that Pd/C materials prepared by either methods exhibit higher H<sub>2</sub> storage capacity compared to their pristine counterparts, which have BET surface area following the order: ACF (1546 m<sup>2</sup>/g) > CMK-5 (1341) > CMK-3 (1024) > AC (1038) > FDA-15 (794). Compared to Pd/C prepared by one-pot synthesis method with a similar Pd loading of 8 wt%, those fabricated by post-synthesis impregnation appear to be more effective in terms of their H<sub>2</sub> storage capacities, which obey the trend: Pd/CMK-5 (0.57 wt%) > Pd/ACF (0.50) > Pd/AC (0.46) > Pd/CMK-3 (0.41) > Pd/FDU-15 (0.30). Among them, Pd/CMK-5 prepared by post-synthesis impregnation method showed the best H<sub>2</sub> uptake capacity of 0.57 wt%. This is attributed to the better dispersed Pd metal particles in Pd/C adsorbents prepared by post-synthesis impregnation method than direct synthesis route, as verified by results obtained from TEM measurements. The effect of Pd loading on H<sub>2</sub> uptake phenomena will also be discussed.

**Keywords:** Hydrogen storage; Porous carbons; Impregnation, One-pot synthesis, Pd

報告型式：☐口頭    ☒海報    ☐皆可

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