

# Synthesis of Highly Porous Graphene Aerogel for Hydrogen Storage Application

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Over the next 30 years, it is expected that two major concerns will become increasingly serious: (i) the decreasing world supply of fossil fuels, and (ii) the increasing rate of global warming and climate change. These two issues are closely accompanied by the rising energy demands of society. In efforts to limit the use of fossil fuels, one attractive strategy which has been identified is the implementation of the technologies enabling the use of hydrogen. However, the feasibility of a hydrogen economy is challenged by the realization of practical storage means. Conventional storage systems like gas or liquid hydrogen tanks are too large for mobile applications. The solution is to use materials and in particular adsorption materials with high surface area has potential to store high amount of hydrogen.[1] In fact, material's adsorption capacity has a complex dependency on several factors including the effectively accessible surface area, the pore size, surface topology, chemical composition of the surface, and the applied pressure and temperature.

In this work, we prepared a graphene aerogel through facile method using a wet chemistry process enabling a scale up production in the future. It was simply synthesized through self-assembly formation of reduced graphene oxide by ascorbic acid in an aqueous environment. Remarkably, the porosity of this aerogel can be altered through simple evaporation of the water within the pores of the aerogel after synthesis. Then, it can retain the pore sizes by further removal of water through freeze drying process. To increase the hydrogen adsorption via spillover effect, the aerogel then were decorated by Pd nanoparticles used to split the hydrogen molecules selected as catalyzer for its superior catalytic activity with respect to other transition metals.[2] The decoration process involved self reduction of Pd salts by the oxide groups entangled within the graphene. This led to formation of small Pd nanoparticles (Figure 1) spillover within the pores of the aerogel. In this work we will show the results from XRD, TEM, XPS, BET analysis and SEM used to characterize the material properties.

## References

[1] Dillon, A.; Heben, M., *Applied Physics A* 2001, 72 (2), 133-142

[2] Zacharia, R.; Kim, K. Y.; Kibria, A. F.; Nahm, K. S., *Chemical physics letters* **2005**, 412 (4), 369-375.

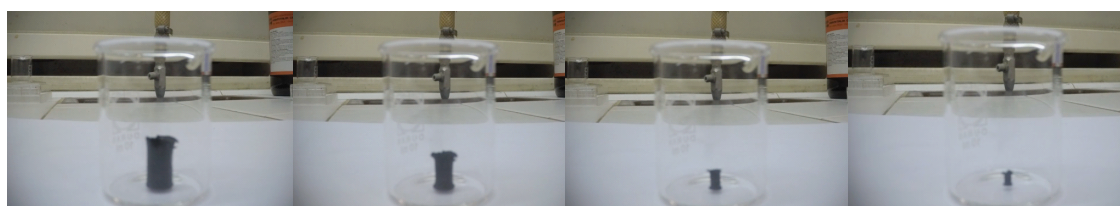


Figure 1. Aerogel shrunk as the water evaporates (from left to right: 0h, 2h, 4h, 6h)

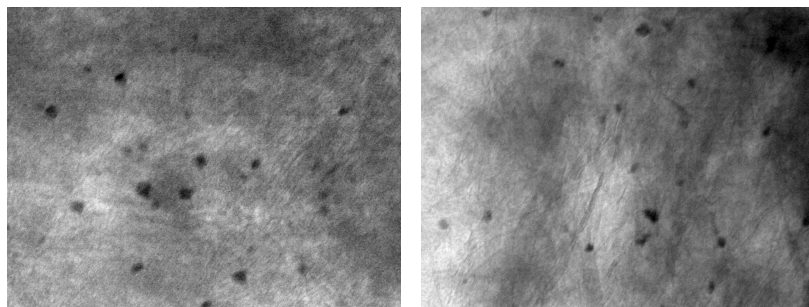


Figure 1: TEM images of the Pd nanoparticles spillover on the aerogel.