

## Mechanism of high surface area graphenic foam production and its application for electrochemical energy conversion

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Since Novoselov and co-workers isolated a single-atom-thick graphene sheet in 2004, interest in graphene has grown continuously to give rise to what might be called the “graphene gold rush”. Graphene have emerged as likely candidates for a wide range of electrochemical energy-storage applications, driving research into novel synthetic techniques to produce graphene with appealing properties. Bottom-up synthesis is one of the scalable route to produce graphene foam with high quality, high purity, high yield and relatively low cost.

The mechanism of sodium ethoxide decomposition, as one of the critical synthetic steps, has been thoroughly studied in this research to produce graphenic foam with controlled properties. Both decomposition temperature and heating rate have a strong influence on the final graphenic foam. Optimization of the decomposition process yields production of graphenic foam with extremely high surface area approaching theoretical calculation. The morphology and H<sub>2</sub> adsorption characteristics of optimized porous graphenic foam network was further investigated as hydrogen storage material. This optimized material is capable of more than 4 wt% H<sub>2</sub> storage at 77K and 10 bar, ranking as the highest hydrogen uptake capacity ever reported for graphitic carbons.

Highly porous graphenic foam with large surface area was further decorated with different metal oxide nanoparticles for electrochemical conversion applications. For its 3D structure we believe graphenic foam can play a significant role as a catalyst support in heterogeneous catalysis. For this purpose we prepared CeO<sub>x</sub> islands uniformly dispersed on the graphenic foam using hydrothermal approach. Graphenic foam decorated with titania nanoparticles has been studied as photocatalysts for hydrogen evolution from water using a methanol sacrificial reagent, under UV-vis irradiation. Use of the graphenic foam support significantly enhanced the photocatalytic activity compared with pure TiO<sub>2</sub> nanoparticles, using a carbon black support, or reduced graphene oxide supports reported in the literature. The enhanced activity is attributed to the large surface area of the support, and intimate contact between the carbon support and the metal oxide particles, suppressing charge recombination and therefore increasing photocatalytic performance.

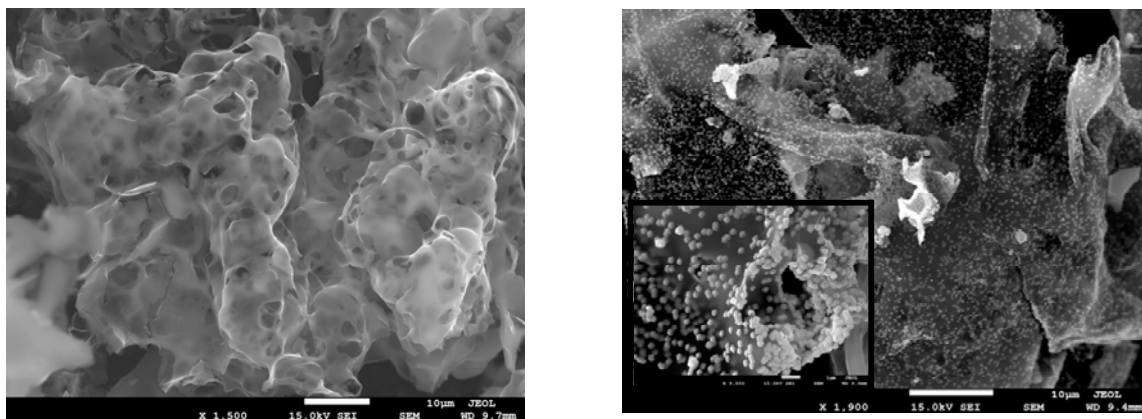


Fig. 1: (left) graphenic foam, and (right) CeO<sub>2</sub> islands deposited on graphenic foam via hydrothermal process.