Improving hydrogen storage of graphene at room temperature with transition metal (Ti, Fe, Ni, Cu) functionalization

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Abstract

Hydrogen, owing a large chemical energy density per mass of ~39 kWh/kg has drawn much attention as a next-generation energy carrier for mobile and stationary power sources. The key problem of hydrogen utilization for the storage systems is finding materials that can store hydrogen efficiently. Unique properties of graphene such as low density, high specific surface area (2630 m2/g in the ideal case), and good reversibility make it a very attractive candidate for energy storage applications. However, low hydrogen storage capacity at ambient temperatures is the main disadvantage of pristine graphene.

Here, we report the preparation and characterization of graphene decorated with transition metal (Ti, Fe, Ni and Cu) oxides. All nanocomposites were characterized by scanning electron microscopy, X-ray diffraction and Raman spectroscopy and nitrogen adsorption-desorption isotherms. Hydrogen storage measurements were made at room temperature and pressures relevant for practical on-board storage systems.

All nanocomposites showed higher hydrogen storage capacity compared to parent graphene in which TiO2 nanoparticles improved hydrogen uptake of the system by 125%. This higher hydrogen uptake was related to strong attachment of highly distributed nanoparticles to the underlying graphene sheets.
Keywords: Graphene, hydrogen storage, transition metal oxide

References

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Figures

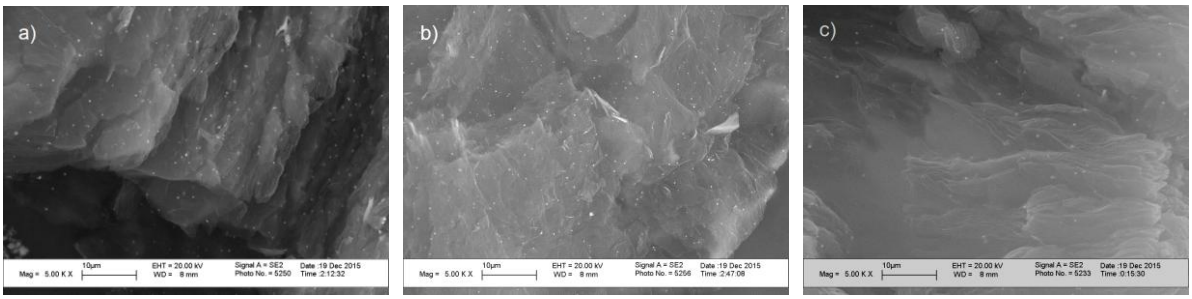

Fig. 1. SEM images of a) Cu b) Ni and c) Fe decorated graphene