

Development of high-capacity composite materials based on single walled carbon nanotubes encapsulated by palladium for hydrogen storage

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In search of novel approaches providing safe and effective hydrogen storage, an alternative nanostructured material, representing Single-Walled Carbon Nanotubes (SWCNTs) encapsulated by thin electroplating Pd layers onto a Pd substrate has been developed in A. N. Frumkin Institute. A synergetic effect resulting in combination of the Pd and the SWCNTs properties with regards to hydrogen has been achieved. We found that this material (Pd-SWCNT-Pd, Fig.1) shows a large hydrogen capacity in the range of 8–12% wt. with regards to the added SWCNTs. We also demonstrated that hydrogen absorption occurs mainly within the interior of the SWCNT and depends on the SWCNT type. The activation energy of the hydrogen desorption from the SWCNT in this composite material was 0.15 eV/H₂-molecule, thus indicating relatively weak hydrogen binding in the nanotubes, allowing reversible H₂ desorption from the SWCNTs below 45°C (Fig.2) [1].

The developed approach to electrochemical synthesis of high capacity composites for hydrogen storage contain a significant potential with regards to practical applications in the hydrogen energetic. In particular, it allows to provide a full hydrogen conversion cycle (from H₂ effective storage to the energy production) in the frame of the works directed to develop effective fuel cells.

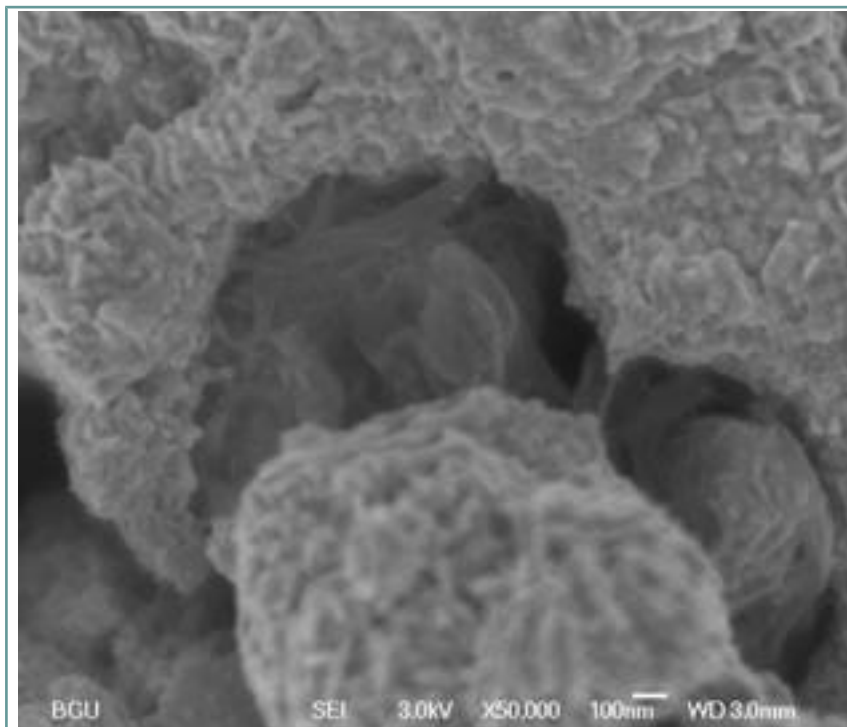
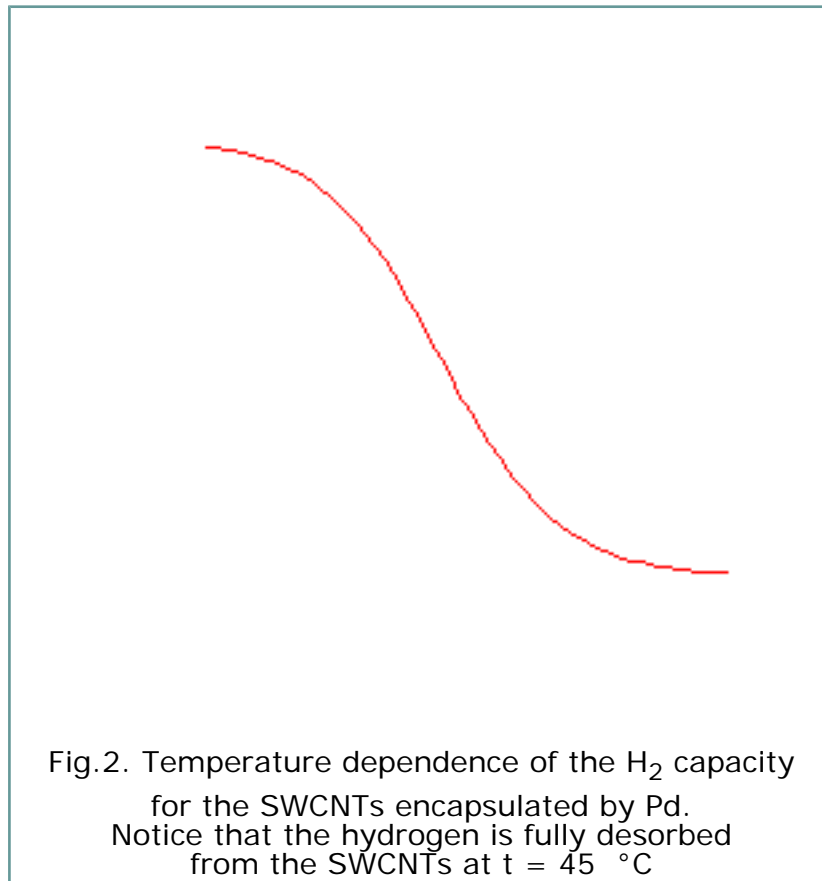


Fig. 1. High resolution SEM interface image of the Pd/SWCNT/Pd sample ($\times 50000$): the SWCNT structure appears as aggregates (image appears in the center), surrounded by metallic Pd (image in light color surrounded by SWCNT aggregates)



Reference

1. G. Lipson, B. F. Lyakhov, E. I. Sauinin and A. Yu. Tsivadze, "Evidence for Large Hydrogen Storage Capacity in Single-Walled Carbon Nanotubes Encapsulated by Electroplating Pd onto a Pd Substrate", Phys. Rev. B, Rapid Communications, 77, 081405(R) (2008).