Homogeneous hollow carbon nano-spheres from renewable resources as novel supports for PEM fuel cell electro-catalysts.

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There is an ongoing need for new supports for Pt and other precious metals in fuel cell electrodes that will enhance the performance of these expensive catalysts. We report here a novel method for the synthesis of extremely homogeneous samples of carbon nano-spheres from cellulose char and their use as catalyst supports for fuel cell applications.

We have shown that when cellulose is charred under an inert gas that it forms a structure containing polycyclicaromatic hydrocarbon, PAH, moieties that anneal with charring time in to larger and larger arrays.[1] When the cellulose is charred with 10wt% Nickel chloride and subsequently irradiated with a CO_2 laser hollow carbon nano-spheres are formed together with other carbon materials.[2] These carbon nano-spheres are readily purified from the mixture by a digestion with hot concentrated HNO_3 overnight to give extremely homogeneous samples of hollow carbon nano-spheres, diameter 40nm, Figure 1, in relatively good yields, >10% in relation to the starting uncharred cellulose.

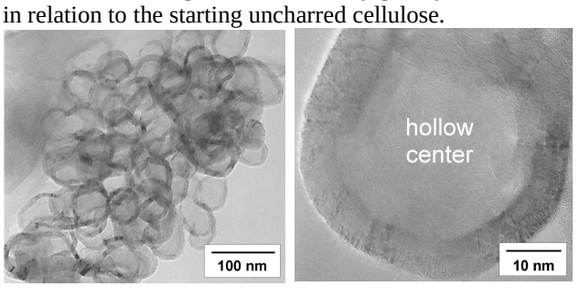

Figure 1. TEM of carbon hollow nano-spheres

Platinum supported catalysts were prepared by analogous methods to those that have been employed for single-walled carbon nano-tubes.[3] The purified carbon nano-spheres are functionalized by a weak oxidation, using a mixture of dilute nitric and sulfuric acids to give a material with carboxylic acid functionalities. Pt particles are attached by reduction of K_2PtCl_4 in ethylene glycol. The resultant material contains 5nm Pt particles attached to the 40nm carbon nano-spheres, Figure 2.

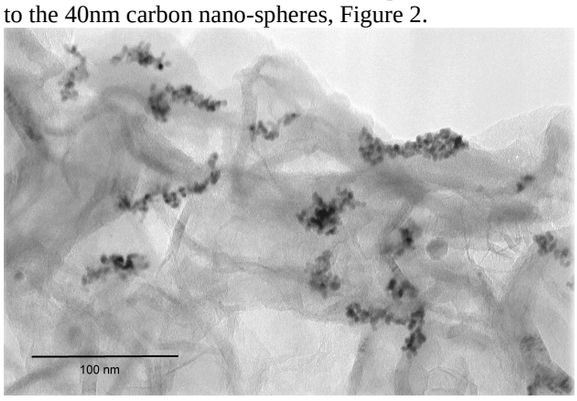

Figure 2. TEM of Pt supported on hollow carbon nano-spheres.

Results of the characterization of these catalysts by XRD and TEM will be discussed as well as preliminary measurements as the anode of a PEM fuel cell.

References

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