Networked Graphitic Structures Grown from Dense Microemulsions as High Performance Electrode Material

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Networked Carbon Graphitic structures, here called Carbon Nano Networks (CNNs) are synthesized by fixed bed thermal Chemical Vapor Deposition (CVD) catalyzed by metal nanoparticles, e.g Ni, Pt, Co [1]. The precursor allowing the formation of this special networked structure is the bicontinuous microemulsion in which catalyst nanoparticles can be synthesized at exceptionally high yield [2,3]. In fact, as the temperature goes up to 700°C, the surfactant starts to carbonize (250-600°C) by preventing nanoparticles aggregation (Figure 1). The NPs are in such way entrapped in a fixed matrix, and their high density allows the growth of interconnected nanotubes (Figure 2). Depending on the feed composition, the dwelling time, the reaction temperature, the support for the catalyst, the catalyst composition (Fe, Co, Ni, Pt…) and the surfactant used different morphology and product composition can be achieved.

Especially, CNNs were grown directly on carbon paper, Figure 3. An homogenous, high surface, conductive layer was obtained. Graphitic nature was proven by Raman spectroscopy (Figure 4) and high oxidation resistance by TGA (Figure 5), resulting suitable as electrode for example in Fuel Cell applications. Platinum nanoparticles were electrodeposited on the surface of CNNs and characterized by XRD. Performance as catalyst support in PEM fuel cells was tested by Cycling Voltametry and Accellerated Durabillity tests. The electrode exhibited very high catalyst utilization and durability compared to commercial catalysts, due to the cleanness of the synthesis method and the high oxidation resistance of CNNs.

REFERENCES

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3. Negro, E; Latsuzbaia, R; Koper, G; *High Yield wet synthesis of Ultrafine Nanoparticles: Kinetics and Control*. 2013. In Preparation.

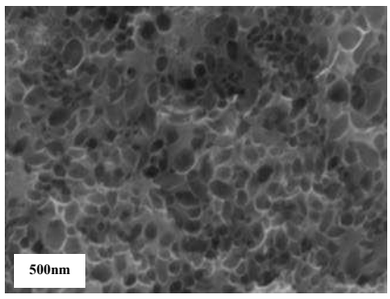

Figure 1. CNNs precursor

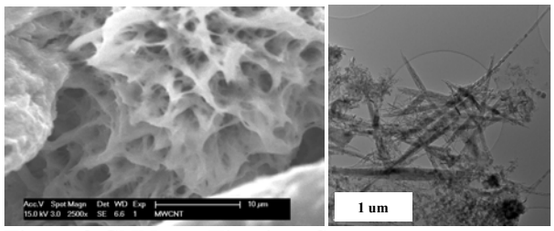

Figure 2 CNNs on Titanium Support

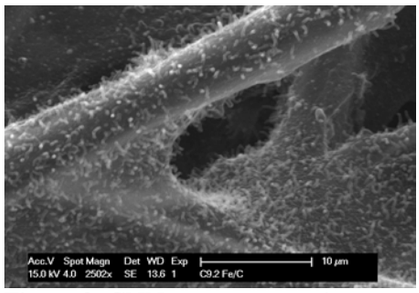

Figure 3. CNNs grown on carbon paper

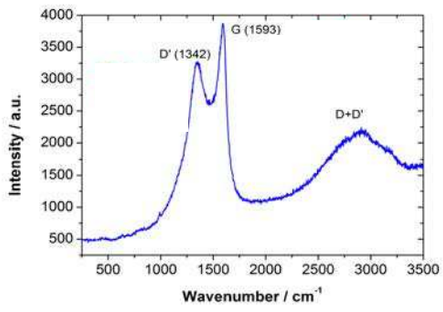

Figure 4. Raman Spectrum of CNNs

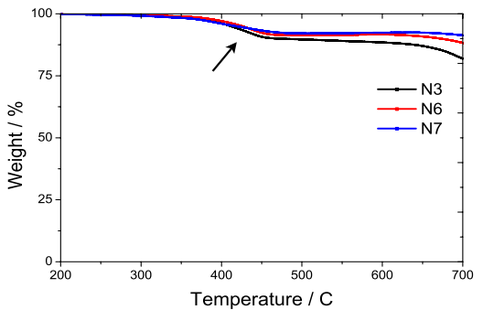

Figure 5. Thermogravimetric Analysis