Characterization of novel carbon xerogel materials for redox flow batteries

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Carbon blacks are commercially used as conductive fillers in bipolar plates (BPPs) as electrodes for redox flow batteries. The degradation of such battery systems during overcharging is a known problem [1]. The type and structure of carbon black play an important role in electrode degradation under highly oxidizing overcharge conditions [2]. Unfortunately, it is impossible to customize the microstructure of carbon blacks. Therefore, there is a need for efficient carbons with tunable properties, which can replace carbon blacks. Carbon xerogels (carbogels) are potential candidates since they provide easy tailoring of porosity along with high electrical conductivity [3]. In this project, we would like to explore the possibility of replacing the standard conductive filler with novel carbogel and, thereby, improving the electrochemical performance of redox-flow batteries.

From preliminary studies, it was found that the replacement of carbon black with carbogel improves the electrical conductivity in BPP. Therefore, here we present a comparison between a commercial carbon black and a carbogel. From the experimental pair distribution functions (PDFs) of these carbons (Fig. 1) and Raman spectra, we observe that carbon black contains slightly larger domain sizes of hexagonal carbon rings and is more ordered. However, the presence of micropores (<1nm) and highly interconnected sp^2-bonded carbon rings as revealed by high-resolution (HR) TEM images could be the major attributing factors for improved electrical conductivity in carbogels.

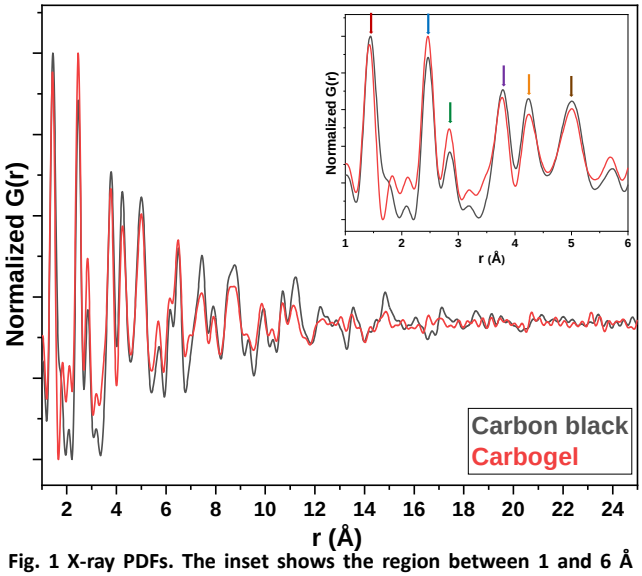

Fig. 1 X-ray PDFs. The inset shows the region between 1 and 6 Å with the assignments to various C–C correlations indicated.

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