Study of structural evolution in low-density, high-strength and high-modulus hollow carbon fibers during continuous stabilization and carbonization

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Carbon fibers are being increasingly used in transportation, energy harvesting, sports goods etc. Over the past three decades, the improvement in the carbon fiber tensile properties has been incremental. To further reduce the weight of composites, it is of great interest to reduce the carbon fiber density, while maintaining or increasing the mechanical properties. With this thought, hollow carbon fibers with a honeycomb structure were produced using an islands-in-a-sea bi-component precursor with polyacrylonitrile (PAN) as the sea component and polymethylmethacrylate (PMMA) as the island component. Using this approach, a density reduction of over 30% and an improvement in the tensile modulus by over 25% has been reported earlier [1]. In order to replace the conventional carbon fibers with the low-density hollow carbon fibers, it is necessary to achieve both superior tensile strength and tensile modulus. Tensile strength is limited by defects. Understanding of the structural evolution during stabilization and carbonization is important to minimize defects. While the structural evolution, to some extent, has been studied for the conventional carbon fibers, it has not yet been reported for the islands-in-a-sea based hollow carbon fiber. This study aims to understand the structural evolution of hollow fibers during continuous stabilization and carbonization and to ultimately further increase their properties.

1. Gulgunje et al. Carbon 95 (2015)