A Fundamental Study in Graphitization Control via Interfacial Templating Using Graphene Additives

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The templating effect of graphene additives on the graphitization of carbon-carbon composites was investigated. Graphene-novolac carbon-carbon composites were prepared using 2.5 wt% of the graphene additives. The four graphene additives used contained varied oxygen content: 1.2%, 5.4%, 15.4% and 30.8%. TEM analysis showed an improved graphitic nanostructure in the graphene-novolac carbon-carbon composites compared to pure novolac. This suggests there is an interaction between the novolac matrix and the graphene additives.

The graphene-novolac carbon-carbon composites made with graphene containing 15.4% oxygen had the most graphitic nanostructure. Selected area electron diffraction showed the formation of sheet stacks in the graphene-novolac composites. XRD analysis revealed a high degree of crystallinity in all graphene-novolac carbon-carbon composite except for the composite made with graphene containing 30.8% oxygen. Calculation of lattice parameters revealed the composite made with graphene containing 15.4% had the highest values for La and Lc, making it the most graphitized composite and the composite made with graphene containing 30.8% oxygen had the lowest values for La and Lc, making it the least graphitized composite. It can be deduced that oxygen plays a role in the degree of graphitization of the carbon-carbon composites. There also seems to be a threshold for oxygen content in the graphene to result in a high degree of graphitization in the carbon-carbon composites. These results suggest the possibility of templating by the graphene additives to lead to the formation of a higher graphitic carbon-carbon composite.