UNIFORM SURFACE DECORATION AND INTERFACIAL BONDING OF ALUMINA PARTICLES ON CARBON NANOTUBES BY MICROWAVE TREATMENT

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Keywords: Carbon nanotube, nanocomposites, Aluminum oxide microwave treatment

Abstract

In this research, we uniformly coated Al₂O₃ on multi-welled carbon nanotubes, and by incorporating a microwave treatment step, have increased the interfacial strength between Al₂O₃ and carbon nanotubes via formation of an Al₂OC intermediate.

We use the PAA(poly acrtic acid) as a surfactant and dispersion agent for uniform Al coating. Carbon nanotubes were dispersed in distilled water using PAA, while Al(acac)₃ was also added as an Al⁺³ ion precursor. Microwave treatment was used to selectively heat the carbon nanotubes to generate Al₂O₃ and Al₂OC by thermal decomposition.

SEM and TEM results demonstrate that Al₂O₃ were uniformly coated on carbon nanotube. Thermogravimetric analysis is utilized to measure the quantity of Al₂O₃ produced. Results show a 5 wt% increase for each addition of 1 g of Al(acac)₃ with 1.5 g of fixed CNT quantity. X-ray results indicate the presence of Al₂OC. By increasing microwave treatment time, we found that the Al₂OC peak increased in intensity. This indicates that microwave treatment significantly contributes to Al₂OC forming. Further, X-ray photoelectron spectroscopy was used to analyze chemical binding, and confirms that Al is covalently bonded to carbon and oxygen. We expect that this covalent bonding is a result of the interfacial reaction between Al₂O₃ and carbon nanotubes.

Fig 1. X-ray diffraction result show Al₂O₃ and Al₂OC were successfully formed(left-top) and X-ray photoelectron spectroscopy result clearly show the Al-C covalent bond(right-top). Transmittance electron microscopy(left-bottom) and elements mapping(right-bottom) observe the uniform decoration of Al₂O₃ nanoparticles on carbon nanotube surface.