Carbon Nanotube Reinforced Composite Films on Aluminium Alloy

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Key words: Nanocomposite, Carbon nanotube aluminium alloy

Since their discovery, multiwalled carbon nanotubes (MWNT) have been used extensively as reinforcement materials for a variety of composite materials.[1] This has been possible due to the excellent mechanical and chemical properties of MWNTs, such as high physical strength, stiffness and thermal conductivity, and their extraordinary elastic modulus, which are all desirable characteristics for countless materials. One such material that can benefit from the addition of MWNTs is aluminium-silicon powder, which is used as a wear resistant coating in the car industry. Bakshi et al. have prepared composite materials of aluminium-silicon and MWNTs by blending both together in a turbula mixer, after which the composite is deposited onto a substrate using cold-spraying.[2,3] Cold spraying works by accelerating particles to supersonic velocities under high pressures to strike a surface, after which they bond to the surface through thermal softening. Films formed in this way were found to have a uniform distribution of carbon nanotubes throughout the powder and had elastic module values from 40-229 GPa.

We have investigated the preparation of MWNT/aluminium-silicon composites (0.5%, 1.0% and 2.0% MWNT) using the method of ball-milling, and are currently preparing films of these composites on aluminium alloy using a number of techniques including plasma spraying thermal spraying, high velocity oxy-fuel method and arc-discharge.

Results will be presented in our poster to show the properties of composites before and after coating using the following techniques:

(i) RAMAN/FE-SEM; MMU has a unique instrument which combines these 2 techniques to focus simultaneously on a specific area of sample, which gives images and spectra of MWNTs showing location and degree of mixing with aluminium-silicon powder,

(ii) HR-TEM; location and degree of mixing of MWNTs with powder, and crystal phases at interfaces of MWNT/aluminium-silicon/aluminium alloy substrate,

(iii) XRD; structural characterisation

(iv) TGA/DSC; thermal properties.

(v) Mechanical testing; a range of physical tests will be conducted to determine the hardness and wear resistance of the films to determine the effects of MWNT concentration and spray method.

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