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Interfacial Analysis in AZ31B Magnesium Alloy Reinforced with Multiwalled Carbon Nanotubes

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Metal matrix composites (MMCs) have applications in many industries. In particular, magnesium alloys and composites are interesting for both scientific research and commercial applications because of their low density [1]. The multiwalled carbon nanotubes (MWCNTs) have been considered as an ideal reinforcing material to improve the mechanical behavior of alloys due to their mechanical properties [2]. Because of this, researchers around the world have been studying several processes and methodologies for developing new light materials reinforced with carbon nanotubes [3]. In this way, a novel technique, called sandwich technique, was reported to be successful in producing MMCs, such as AZ31B magnesium alloy reinforced with MWCNTs, with good mechanical properties [4]. The mechanical properties of the light composite depend on the chemistry, atomic structure and the bonding at the interface, since this is the region where the mechanical load is transferred from the light matrix to the reinforcement. In this study, the interface between AZ31B magnesium alloy and MWCNTs were studied by microscopy techniques, in order to understand the good mechanical properties reported in our previous work [5].

Figure 1 shows TEM and HRTEM images of the raw MWCNTs, which reveal outer diameters ranging from 10 to 40 nm, inner diameters between 10 and 20 nm and lengths between 30 and 50 µm. Some imperfections, including variable number of carbon layers and amorphous carbon defects, can be identified. Figure 2 presents FESEM images of the composite and a close-up of the interface between the magnesium layers, i.e. the reinforced zones or the MWCNTs-rich zones. In general, this image shows a good dispersion of the MWCNTs; in addition, MWCNTs clusters were not observed, which allows promoting a good load transference between the magnesium matrix and MWCNTs, which in turn produces good mechanical properties. For the interface characterization between magnesium and MWCNTs, TEM and HRTEM techniques were used. Dislocations stacking and coherence or semi-coherence structure between magnesium matrix and MWCNTs were found, as shown in Figures 3 and 4.

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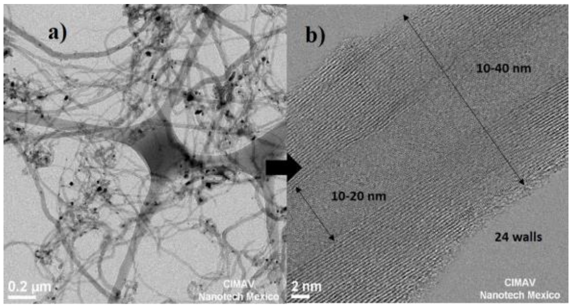

Figure 1. a) TEM and b) HRTEM images of multiwalled carbon nanotubes.

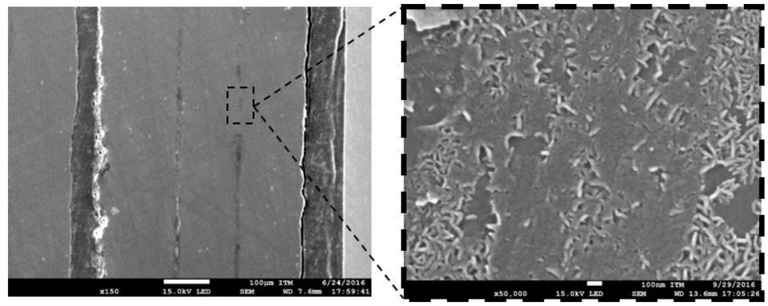

Figure 2. FESEM images of AZ31B magnesium alloy reinforced with MWCNTs.

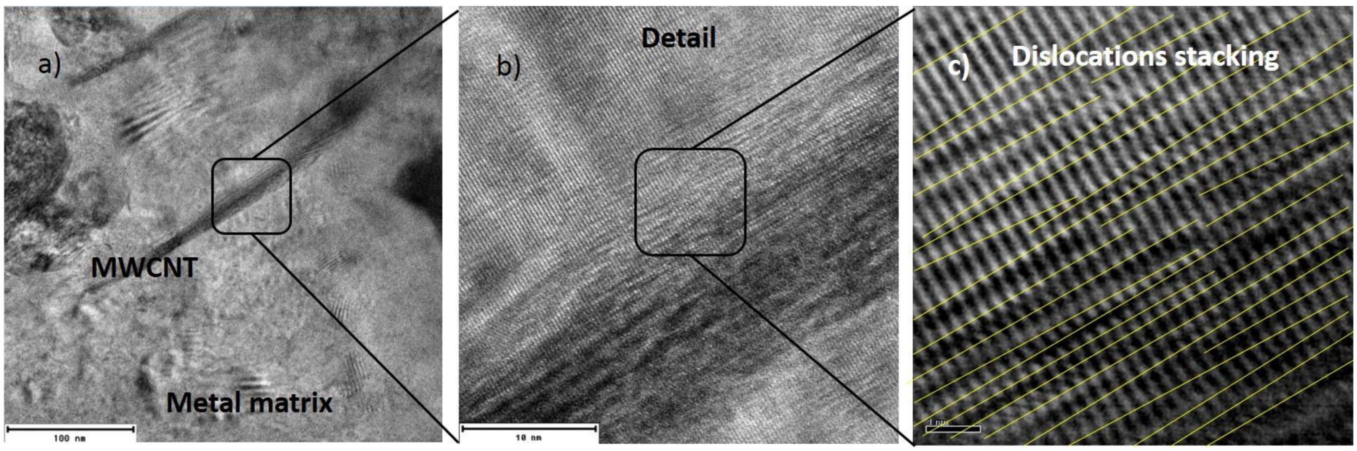

Figure 3. HRTEM images for the composite reinforced with MWCNTs; a dislocation stacking can be seen.

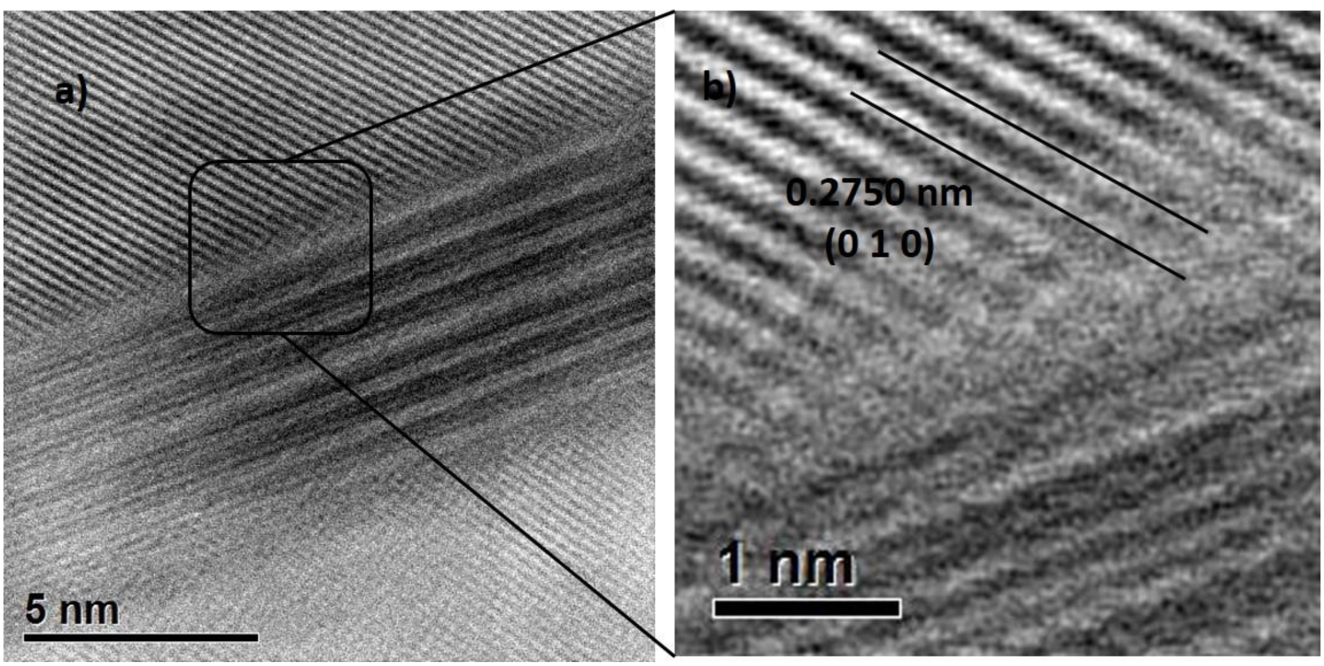

Figure 4. HRTEM images for the composite reinforced MWCNTs; coherence between phases can be seen.

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