Composite material based on polymer matrix reinforced with Al-based Quasicrystal powder

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Composite materials are innovative materials synergistically combined to create a material with enhanced properties and exclusive applications. In this work, we have studied possibilities for a unique combination of the best properties of a technical polymer and a quasicrystalline material for enhanced mechanical properties of such a composite. Quasicrystals (QCs) can offer an excellent compromise between high hardness and low adhesion energy for non-stick applications [1]. We anticipated that these new quasicrystal-based composites will maintain functionality and resist fatigue failure and wear, even under long-term use in normal or extreme conditions.

Scanning electron microscopy (SEM) was used to specify the microstructure of the composite materials with different fillings of $Al_{59}Cu_{25}Fe_{13}B_3$ (at.%) QC into the Polyphtalamide polymer matrix (Fig. 1). Mechanical tests showed that the material breaks differently when we add QC into the polymer. Measurements of the Vickers hardness (load of 200g) of the composite materials indicated that 5 vol.% of QCs added into the polymer matrix does not have a significant influence on the overall Vickers hardness (~ 15 HV) but becomes significant at additions of 30-35 vol.% (~ 24 HV). The surface energy for the composites is between 37 – 39 mJ/m^2, which is comparable to the surface energy of both the naked polymer Polyphtalamide (39 mJ/m^2) and QC equipped with his native oxide layer (average around 37 mJ/m^2) in the air. Conventional metallic fillers like aluminium alloys or stainless steel would make this figure much higher.

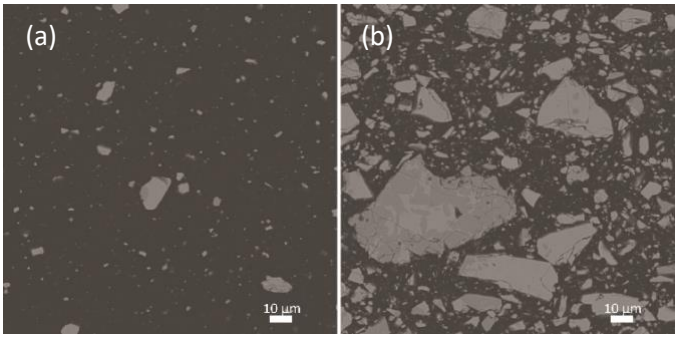

Fig. 1: Representative SEM images of composite materials. (a) PPA reinforced with 5 vol.% of QCs and (b) PPA reinforced with 35 vol.% of QCs.

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Reference: [1]. Dubois, J.-M, *Useful Quasicrystals*. World Scientific, Singapore, 2005, pp. 482.