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Improvement of Mechanical Properties of an Aluminum Alloy 7075 by Adding Reduced Graphene Oxide Trough Mechanical Milling

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Nowadays composite materials have a great area of interest due to their physical, chemical, thermal and mechanic properties compared to the materials obtained through conventional methods of fabrication. A composite material is the union of two materials with a remarkable difference of their properties, these materials are mostly considered by a material (matrix) surrounded by fibers or particles of higher stiffens (reinforcer).

It has been reported that graphene (GPN) have a high fracture resistance of 125 GPa which make it an excellent option as a reinforcer [1]. A probe of this can be seen by the addition of graphene into an Al-6061 alloy matrix trough mechanical milling and hot pressing that shown an increment of 47% of tensile resistant compared to the Al-6061 alloy without graphene addition [2]. Also, graphene shows a high adherence into an aluminum matrix due to his high surface area [3]. Another kind of interaction between a copper metal matrix and adding graphene by mechanical milling has been seen in which the graphene tends to be distributed in the grain boundaries [4].

By previous experiments in the laboratory, it could be found that an addition between 0.3 and 0.8wt% of GPN into an Al-7075 alloy matrix shows a good improvement of the mechanical properties (σ_y, σ_{max} & hardness). Once knowing that after the compressive tests of the composites a tested billet of the Al-7075 with 0.3wt% of GPN was taken to prepare a sample by FIB and then to be analyzed by TEM to find the interaction between the GPN and the Al-7075 matrix.

Figure 1, shows how the addition of 0.3wt% of GPN is compared to a non-addition of graphene into the Al-7075 matrix in which we can see an improvement on the yield strength from 387.27 MPa to 405.82 MPa immediately by just adding the graphene to the matrix. Also, a major percent of strain can be observed as an effect of the 0.3wt% of GPN on the matrix.

In figure 2 (a) can be seen how graphene is distributed on the grain boundary as previously mentioned, this can be attributed to the mechanical milling process in which the graphene tends to a cold-welding process to the surface of the Al-7075 particles. Figure 2 (b) is a clear example of how the grain boundaries stop dislocations and also graphene can contribute to a reinforcement of the grain boundaries [5].

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[5] The authors acknowledge to the Red Temática Nacional de Aeronáutica, Red Materiales Compuestos and Red Temática de Nanociencias y Nanotecnología (152992).

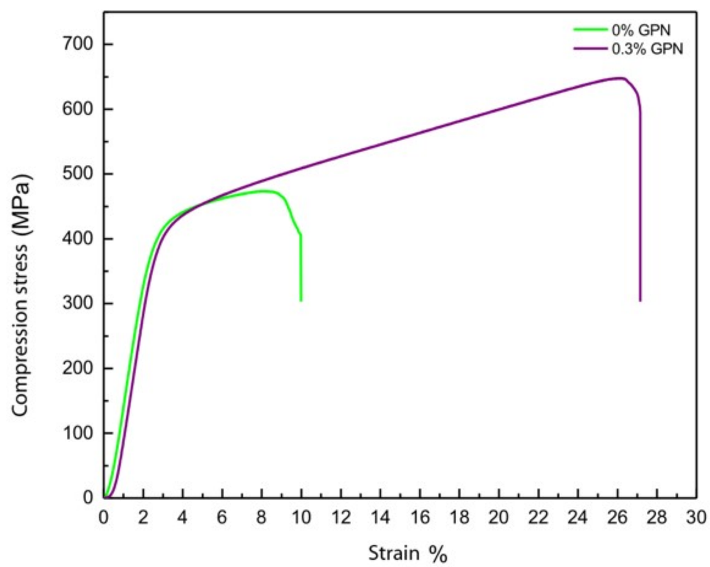

Figure 1. Room temperature compression stress strain compression curves of 0.0wt.% and 0.3wt.% GPN.

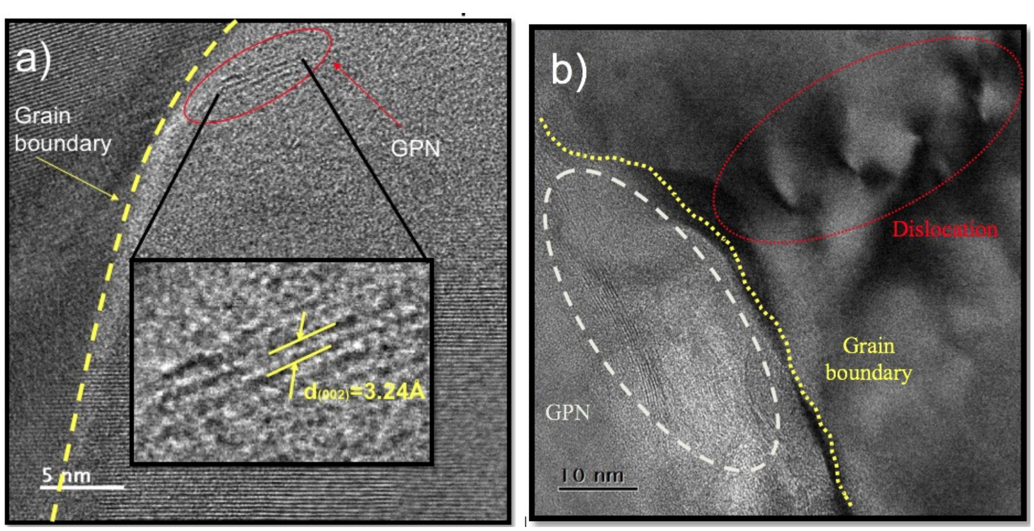

Figure 2. The interaction between graphene, grain boundary, and dislocation.

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