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Strengthening of an Al 7075 Alloy with Graphene Synthetized by an Environmental Friendly Method

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Composite materials are obtained by the union of two or more materials to achieve a combination of properties which are not possible to obtain on its original form. These composites can be chosen to get unusual combinations of strength, stiffness, resistance, weigh, high temperature performance, corrosion resistance, hardness and/or conductivity. Composites can be classified in three categories depending the form of the reinforcement material: With particles, fibers and laminar. [1]

In this work we will focus on the characterization of the graphene obtained by the dry ice method of synthesis and the interaction between graphene and the aluminum alloy 7075 metal matrix processed by a planetary ball mill and the effect on its mechanical properties. There are several ways to produce and reinforce aluminum alloy by mechanical milling. Some of them have fast and good results as high energy mill, the problem with this kind of mill is the low percentage of obtained material in relation with planetary ball mill as in this case, in which the relation of obtained material by running is 44 g for the planetary mill versus 8 g obtained by high energy mill.

The graphene used as reinforcement was obtained by burning metallic Mg inside a CO_2 atmosphere in a cavity of dry ice. The product of the chemical reaction is a powder mixture of unreacted metallic Mg, MgO and graphene which latter were cleaned in a 1:1 solution of HCl and deionized water and vacuum filtered to remove the $MgCl_2$ produced doe the reaction of the HCl with the MgO and the metallic unreacted Mg [2]. Graphene powders were morphologically characterized by TEM using a JEOL JEM 2200FS+CS.

The composites where obtained using a FRITSCH Planetary Micro Mill PULVERISETTE 7 processed for two hours. The additions of graphene for the composites were the following ones: 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 (%vol.).

Transmission electron microscope (TEM) images of graphene and the interaction between the graphene and the Al 7075 alloy are shown in Fig 1. Fig. 1a shows multi-layer graphene structure. In fig. 1b it is visible that the graphene had basically no interaction with the Al 7075 particles.

Figure 2. shows the results on the yield strength of the composites, the results were obtained by performing compression test on each composite. This figure shows a non-linear behavior that can be contributed to the non-interaction between graphene and Al 7075 particles [3].

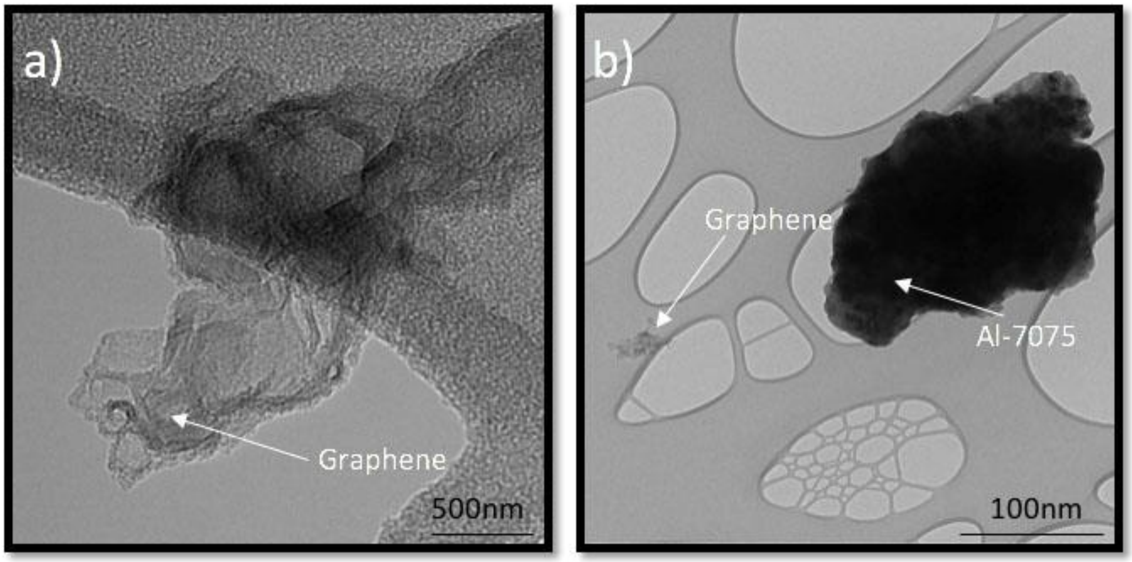

Figure 1. a) TEM image of graphene. b) TEM image of the no interaction between Al 7075 particle and graphene.

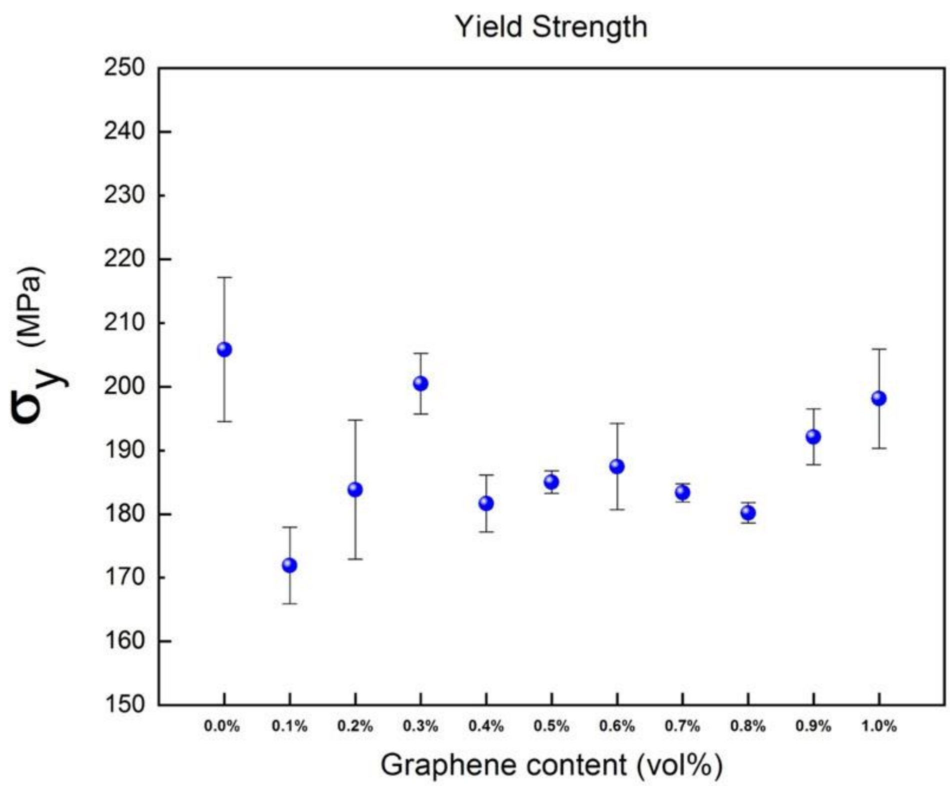

Figure 2. Yield strength of the Al 7075/Graphene composites obtained by low energy planetary mill.

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