INFLUENCE OF DISPERSION OF GRAPHENE OXIDE AND REDUCED GRAPHENE OXIDE ON POLYURETHANE IN GAS PERMEATION

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1 Introduction

Polymer nanocomposites have attracted great interest both in academic and industrial terms, due to the potential for significant increase of properties obtained with small amounts of nanoparticles added to the polymer matrix [2]. The graphene oxide, combined with polymers, has shown an impermeable nanocomposite barrier to gases and liquids [5] and from this perspective it has attracted a particular interest for applications on oil and gas industry. In many cases, nanocoating acts as protective film that may prevent future corrosion problems [1] and extend the devices lifetime. In this work, we use ultrasonic Tip to increase the dispersion of graphene oxide (GO) and reduced graphene oxide (RGO) on polyurethane compared to using only magnetic stirrer. The samples obtained have been tested in a permeation analysis system. Friction measurements were taken using a micro-tribometer in a ball-on-flat contact geometry with a stainless steel ball as the counterbody. The coating films were studied by scanning electron microscopy (SEM), optical microscopy, atomic force microscopy (AFM) and Raman Spectroscopy.

2 Experimetal

The manufacturing process of the samples occurred as follows: first the polyurethane and solvent THF (tetrahydrofuran) are left in magnetic stirring for 24 hours, then is added the Graphene (GO or RGO) used in ultrasonic tip and left for another 24 hours in magnetic agitation before being spread on a camera in THF saturated for the membrane formation. After the formation of the membranes, they were tested in the permeation system and friction behavior.

The Raman spectrum obtained on the samples with GO and RGO proved the presence of graphene in both [3]. The figure 1 shows the Raman spectrum obtained on the sample with GO and the figure 2 shows the sample with RGO.

The permeation system consists of a cell fed by a gas (CO2) at constant pressure, the membrane is placed inside the cell to hinder the passage of gas. After the membrane is attached a pressure transducer. As the pressure increases on the transducer and these data are acquired for a computer, it is possible to correlate the pressure curve obtained with the tested membrane permeability.

The friction behavior test were conducted using a micro-tribometer CTER-UMT under linear reciprocating sliding configuration performed at constant load 1 N to access the friction coefficient. [4]

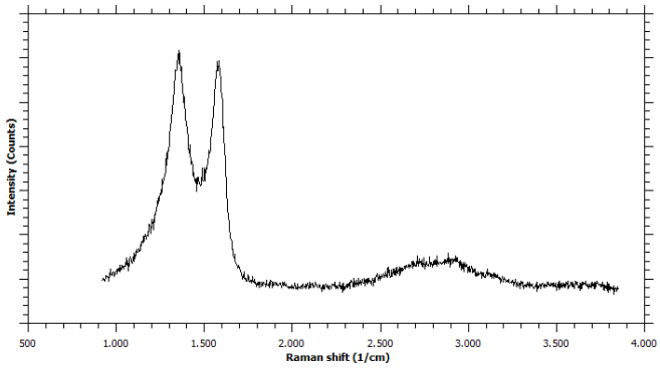

Figure 1: Spectrum Raman GO/PU nanocomposite

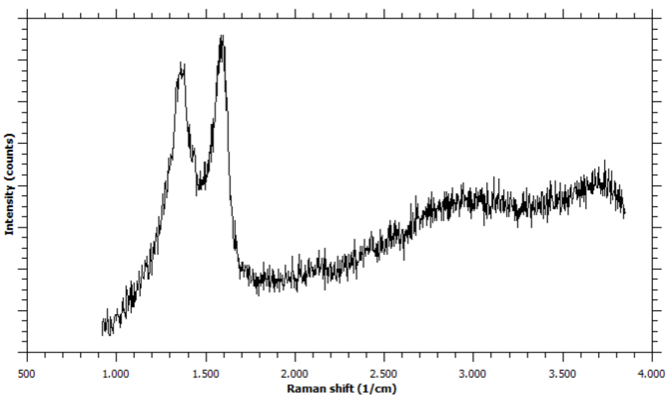

Figure 2: Spectrum Raman RGO/PU nanocomposite

3 Results

The analysis of Graphene dispersion by different methods of manufacture of samples can be evaluated. Figure 3 shows the characterizations made by optical microscope samples of GO/PU (a) and RGO/PU (c) without using the tip, in comparison with the samples GO/PU (b) and RGO/PU (d) using the ultrasonic tip.

SEM microscope was used to obtain a greater magnification on the flake of Graphene. Figure 4 (a) shows the cluster of GO in the sample that has not been used the ultrasonic tip. While Figure 4 (b) shows the Graphene better dispersed in the sample who used the ultrasonic tip.

The analysis of the morphology of the surface was performed through the AFM. Figure 5 shows the morphology of samples (a) GO/PU and (b) RGO/PU both manufactured with the use of the ultrasonic tip.

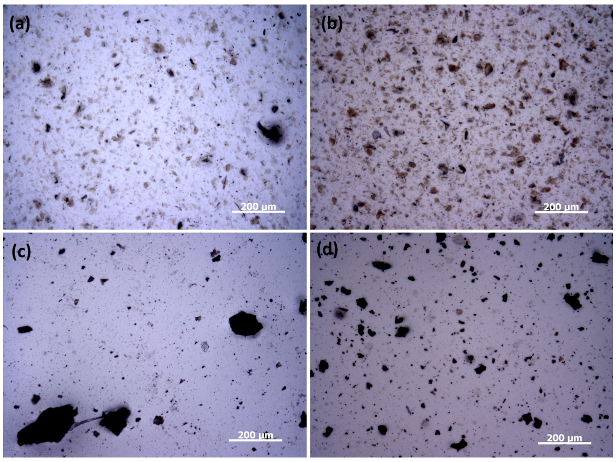

Figure 3: Optical microscope images. (a) GO/PU without using Ultrasonic tip, (b) GO/PU using ultrasonic tip, (c) RGO/PU without using Ultrasonic tip, (d) RGO/PU using ultrasonic tip.

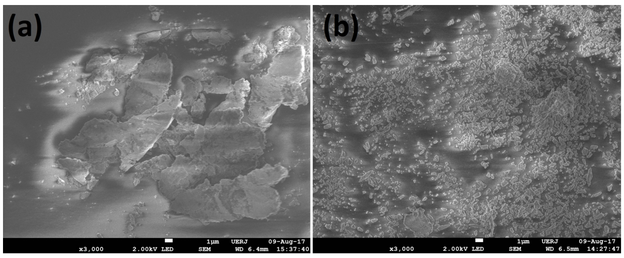

Figure 4: SEM microscope images. (a) GO/PU without using Ultrasonic tip, (b) GO/PU using ultrasonic tip

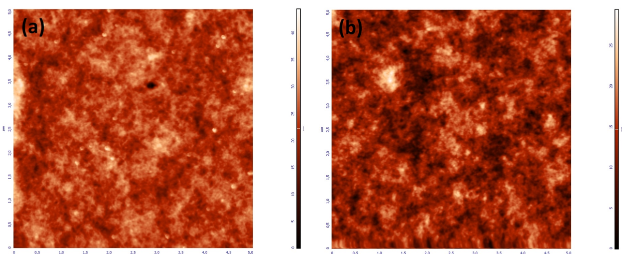

Figure 5: AFM microscope images. (a) GO/PU without using Ultrasonic tip, (b) GO/PU using ultrasonic tip

4 Conclusions

After the analysis of the optical microscope images it is possible to affirm a better dispersion of the flakes of Graphene from samples of GO and RGO who used the ultrasonic tip in your manufacturing, in comparison with the samples that were manufactured only by magnetic stirring. The observation of the flakes to GO in greater magnification, through the SEM, can check a better distribution of the sample used the ultrasonic tip. AFM images revealed no significant differences in morphology between the samples examined. In this way, it can be concluded:

- ultrasonic probe in manufacturing of membranes improved Graphene dispersion in polyurethane;
- It is Expected a better performance of the samples using the ultrasonic tip for permeation test, once a more homogeneous dispersion of the Graphene contributes to improving the barrier against gas passage in these membranes;

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