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Investigation on the influence of carbon nanotubes on the thermal behavior of graphite-PPS composites

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Abstract – PPS-graphite-carbon nanotubos composites have been prepared by compression molding. Flakelike graphite particles were used as the main conductive filler. Multi-walled carbon nanotubes (MWCNT) were added to the composites in order to increase their electrical conductivity. The influence of MWCNT addition on the thermal behavior of the composites was investigated by means of DSC and TGA. DSC curves showed a double melting behavior, independently of the MWCNT content. The thermal stability of the nanocomposites was little affected by the addition of MWCNT although a slight increase in the onset weight loss temperature has been observed as the MWCNT content became higher.

Graphite-polymer composites are suitable materials for bipolar plate of proton exchange membrane fuel cells (PEMFC). The use of polyphenylene sulfide (PPS) as the matrix of these components has been considered as a mean of increasing the temperature operation of PEMFC. Furthermore, carbon nanotubes may raise the electrical performance of graphite-polymer composite bipolar plates and also interfere on their thermal stability. In this work, the influence of MWCNT addition on the thermal behavior PPS-graphite composites has been evaluated by means of DSC and TGA. The graphite particles were natural with flakelike morphology. Two different PPS weight fractions have been used, 30 and 40 wt%. As the results were similar in both cases, indicating the same tendencies Only those related to the weight fraction of 30% are presented here. Nanocomposites containing 5 or 10 wt.%-MWCNTs were prepared via compression molding. DSC and TGA measurements were performed under N_2 flux under a flow rate of 30 mL.min^{-1} and a heating rate of 10 ºC.min^{-1}. DSC curves presented a double melting peak as shown in Fig. 1. This behavior has been ascribed in the literature to the presence of crystals with different sizes in the polymeric structure [1]. It is seen that the melting temperatures are little affected by the addition of MWCNTs. The thermograms of Fig. 2 present a single degradation pattern. The onset of thermal degradation was 513ºC for the composite without MWCNT addition, 517ºC for the nanocomposite with 5 wt.%-MWCNT and 539ºC for the nanocomposite with 10 wt.%-MWCNT. There was an increase of the thermal stability of the composite with MWCNT incorporation. This effect was observed for other polymer-carbon nanotubes composites [2,3] and confirm the beneficial role that MWCNTs play on increasing the degradation temperature of polymer matrix composites.

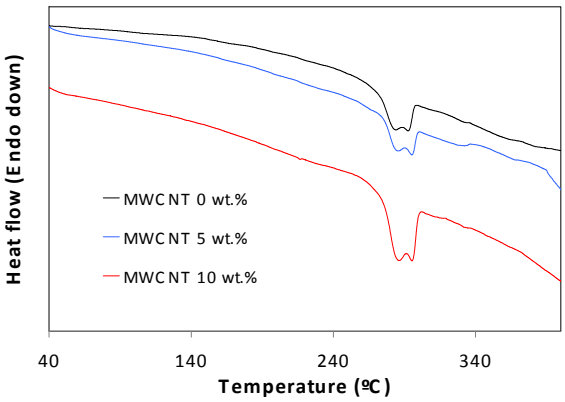

Figure 1: DSC curves of the nanocomposites.

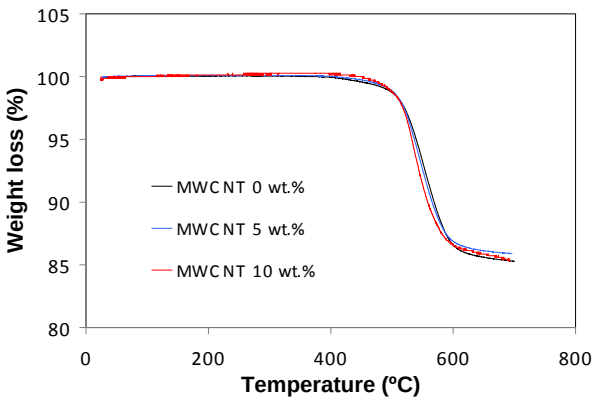

Figure 2: Thermograms of the nanocomposites.

References

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