PREPARATION OF THE FUEL CELL BIPOLAR PLATES BASED ON EPOXY RESIN/GRAPHITE AND POLYBENZOXAZINE/GRAPHITE COMPOSITES

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Nowadays, alternative power energy sources play a crucial role in energy technology [1]. Fuel cells (FCs) have been developed as a candidate for zero-emission and alternative power sources in this field. Bipolar plates (BPs) are a key component of FCs, as they distribute gas, collect current, and remove heat. As a consequence, the creation of polymer-based electrically conductive composites for fuel cells' BPs is important [2]. The balance between the high electrical conductivity, mechanical characteristics, and other properties of bipolar plates is very crucial for the effective work of the fuel cells.

In this work, the polymer composites based on the epoxy resin (ER) and different graphite grades (natural graphite (NG), synthetic graphite (SG), and thermally expanded graphite (TEG)) were prepared by compression molding. Firstly, the thermal properties (T_g and cure state) of epoxy resin were determined by Differential Scanning Calorimetry (DSC), obtaining T_{onset} at 81 °C and T_{max} at 146 °C. For the thermal stability of the polymer and the polymer composites, the Thermogravimetric analysis (TGA) was performed. The electrical properties of the materials have been carried out by impedance spectroscopy. The results of the percolation threshold of NG/ER, SG/ER, and TEG/ER were 11, 6, 3.7 vol.%, respectively. The electrical conductivity of the BPs reaches 130 S/cm (at 90 wt.% of graphite).

Additionally, polybenzoxazines (PBOs) are thermosetting phenolic resins that are formed through the thermal ring-opening of benzoxazine monomers without any catalysts [3]. Their characteristics are high curing temperature (150–250 °C), thermal stability (10 % of degradation at temperatures higher than 300 °C), high glass transition temperature, low flammability, near-zero volumetric change upon curing, good mechanical properties, and other properties, which are required for BPs preparation [3–5]. By preparing and testing PBO-based composites using compression molding, we further demonstrated their potential as a viable alternative material for BPs in fuel cells.

References

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