Investigating electrically conductive polymer composites

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The increasing global energy demand presents significant challenges, particularly within the constraints of complex economic conditions. As a result, the exploration of innovative energy sources has become a priority. One such advanced energy conversion technology is the fuel cell, whose integration into practical applications is critically important. Among fuel cells, hydrogen fuel cells offer a renewable and efficient energy solution. Currently, these cells are mainly produced from metal alloys, which not only increase production costs but also complicate recyclability and contribute to excessive weight. Polymer composite materials present a promising alternative to address these limitations; however, their application requires further development to meet stringent operational demands. Key material requirements include high thermal and electrical conductivity, adequate mechanical properties, and resistance to electrochemical corrosion.

In this study, we used different types of graphite, carbon black, and carbon fiber fillers with polypropylene matrix to manufacture mono-composite materials. We investigated the thermal, electrical, mechanical, and processing properties of the samples to evaluate the effect of the fillers and their special properties. We selected the best fillers based on the results of the mono-composites, such as the highest electrical and thermal conductivity, lowest percolation threshold, and processibility to produce hybrid composites. We investigated how much the hybridization effect enhances the properties of each compound. The newly developed carbon-filler-based composite material for injection molding offers a lightweight and cost-effective alternative for fuel cell applications.

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