Novel High Performance, Low Cost, Polydisperse Carbon Black/Polymer Blend Composites for Bipolar Plates of Micro/Portable PEM Fuel Cells

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Polymer electrolyte membrane or proton exchange membrane fuel cells (PEMFCs) are most suitable for U.S. Army applications as light-weight, micro/miniature/portable fuel cells. This is thanks to their low temperature of operation, perfect CO2 tolerance by the electrolyte and a combination of high power density and high-energy conversion efficiency. However, significant barriers are present before this fuel cell technology can be fully embraced. One of the key barriers is the power density of a fuel cell stack [2]. This issue becomes even more critical when micro/miniature/portable fuel cells are considered. Significant improvements in the power density, however, can be achieved by reducing the profile of the bipolar plates. Traditionally, PEM fuel cells have been constructed from PocoTM graphite, which is resistant to corrosion in the fuel cell environment but suffers from being brittle, expensive, bulky and difficult to machine. Due to the brittleness of graphite, the bipolar plates need to have a thickness in the order of several millimeters, which makes a fuel cell stack heavy and voluminous. Thus, novel materials are needed to reduce the volume and cost of bipolar plates. This one-year research project will address these challenges with the following two specific objectives.

1. Develop a moldable, polydisperse carbon black (CB)/polymer blend composite which has equivalent performance as graphite bipolar plates but with substantially reduced volume and costs.

2. Build a foundation for future development in the fundamental understanding of mechanisms that lead to the high performance bipolar plates to be developed in this project and could result in further improvements in the future.