EFFECT OF COMPRESSION MOLDING PARAMETERS ON GRAPHITE/EPOXY COMPOSITE BIPOLAR PLATES

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ABSTRACT

Bipolar plates (BP) are the key multifunctional component in Proton Exchange Membrane Fuel Cells (PEMFCs) which account for ~30% of the total cost [1], over 80% of the weight, and almost all of the volume in a typical fuel cell stack [2]. BP serve multiple functions: distributing uniform gas flow, facilitating water management, conducting current between adjacent cells, maintaining impermeable hydrogen and oxygen barrier, providing stack structural support, and enabling heat transfer. Therefore, the bipolar plates must meet a variety of property requirements, as shown in Table 1 [3]. Such characteristics may be obtained with a proper choice of starting materials and forming conditions.

BP are commonly composed of pure graphite, metals or metal alloys but lately, graphite-polymer composites have been investigated as bipolar plates materials to maximally utilize the electrical conductivity of graphite and the mechanical strength of polymers and to exploit the benefits of smaller size, lighter weight, easier fabrication, and reduced cost.

Recently we developed a simple but promising graphite/epoxy composite (90 %wt of commercial graphite and 10%wt commercial epoxy resin) able to meet the electrical characteristics required by the US Department of Energy (In-plane electrical Conductivity >100 S/cm). Here we present a study on the effect of compression molding parameters as pressure, temperature and time that were studied on the same composite and analysed using a two-level full factorial Design Of Experiment (DOE) approach. In-plane conductivity and mechanical strength were the dependent variables. The independent variables were controlled through a custom-made press.

Characteristic	Unit	Target
Flexural strength	Mpa	> 25
In-plane electrical conductivity	S/cm	> 100
Through-plane electrical conductivity	S/cm	> 20
Areal specific resistance	Ohm·cm^2	<0.01
Thermal conductivity	W/(m·K)	> 10
Corrosion resistance	µA/cm2	<1
H_2 permeability Std	Std cm3/(s·cm2·Pa)@80 °C, 3 atm 100% RH	$<1.3\times10^{-14}$

Table 1. U.S. DOE Technical Targets for Bipolar Plates [3]

REFERENCES

[1] J. P. Kopasz, T. G. Benjamin, Argonne National Laboratory - 2017 Bipolar Plate Workshop Report.

[2] R. Taherian, *Journal of Power Sources*, **2014**, 265, 370-390.

[3] https://www.energy.gov/sites/prod/files/2017/05/f34/fcto_myrdd_fuel_cells.pdf