TWO-PHASE FLOW REGIME CLASSIFICATION USING FAST FOURIER POWER SPECTRA

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Two-Phase flow regimes in the cathode air channels are under investigation for their effects on proton exchange membrane fuel cell (PEMFC) performance. Efficient water removal from the gas diffusion layer (GDL) and air channels is considered vital to PEMFC performance. Excess water buildup decreases the cross-sectional area of gas channels and limits the diffusion of gases toward the reaction sites, thus starving the chemical reaction. Water buildup also restricts the air flow through gas channels creating a higher pressure drop across the cell. This higher pressure drop has been found to significantly reduce the life of the GDL and increase operating costs. Three flow regimes have been identified and explored, namely slug flow, film flow, and mist flow, and their effects on gas flow have been noted. In order to ensure PEMFCs are operating within the preferable flow regime, a method for the quick identification of flow regimes is of critical concern. Fast Fourier Transforms (FFT), specifically Power Spectra, have shown potential to provide quick classification of two-phase flow regimes. FFT analysis, the process of approximating real world data by the sum of sine waves, is used to define the normalized total pressure drop of the cell by a range of discrete frequencies. The power spectrum of the normalized pressure drop is investigated for current densities of 0.2, 0.4, 1, and 2 A/cm^2 over stoic ratios of 1 to 45. This work provides a basis for flow regime classification through the use of Fast Fourier Transforms.