

Thermal behavior of ash-free coal for high temperature fuel cell

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Direct carbon fuel cell(DCFC) can directly convert the chemical energy into electricity. The theoretical efficiency of this fuel cell slightly reaches 100% and a various kinds of carbon-rich material such as coke, biomass and coal can be used as fuels for the DCFC. Among the carbonaceous materials, especially, coal is commonly used as fuel of DCFC because it can be easily accessible. However, using coal as fuel has a problem that ash formed when coal is burned deposits at anode electrode of DCFC. Recently, ash-free coal is investigated to solve this problem. The ash-free coal is produced by the solvent extraction method so that the mineral matter in coal is extracted into the solvent. It was found that the ash-free coal is initially in the solid state, changes to a liquid-like state at high temperature, which can decrease in activation polarization by enlarging reaction surface at the anode. Therefore, it is important carbon to maintain liquid-like state of ash-free coal. This study deals with thermal behavior of ash-free coal for high temperature fuel cell and thermo-mechanically analyzing the temperature that ash-free coal changes solid state to liquid-like state at CO₂ atmosphere. Experimental results indicate that ash-free coal changes to liquid-like phase in temperature range 200°C~400°C.