Plasma-assisted dry reforming of methane in atmospheric AC gliding arc discharge

XIN TU, HELEN J. GALLON, J. CHRISTOPHER WHITEHEAD, School of Chemistry, The University of Manchester, Oxford Road, Manchester M13 9PL, UK, PLASMA CHEMISTRY GROUP TEAM — Plasma-catalytic dry reforming of CH$_4$ with CO$_2$ has been carried out in an atmospheric pressure gliding arc reactor. Two semi-ellipsoidal Al plates coated with different materials (Ni, Zn and Cu) are used as electrodes. The plasma arc dynamic has been investigated by means of electrical diagnostics and high speed photography. Different arc breakdown regimes are reported, and the restrike mode is identified as the typical fluctuation characteristic of the gliding arc in CH$_4$/CO$_2$ mixture. In addition, global thermodynamic equilibrium calculation for dry reforming of CH$_4$ has been carried out. The effects of both plasma (reactor geometry, coating material and arc power) and process parameters (feed flow rate and CH$_4$/CO$_2$molar ratio) on the conversion, product selectivity and energy efficiency of the process have been investigated to get optimal operating parameters for the reaction. The possible reaction mechanisms involved in the plasma dry reforming chemistry are also suggested.

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