ELECTRODE PHENOMENA IN SEEDED MHD COMBUSTION PLASMA

BY

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(G.V.Rama Raju)

SUMMARY

This thesis presents investigations of current conduction phenomena in potassium seeded combustion products of liquefied-petroleum-gas and oxygen. Current conduction between the electrodes is largely controlled by the boundary layers/sheaths formed over the surface of electrodes (particularly cathodes). Experiments are performed to study the effect of cathode temperature and seeding ratio on current-voltage characteristics, electrode voltage drops and breakdown voltages using copper electrodes. It has been observed that the cathode temperature considerably affects the current conduction phenomena. A theoretical model has been developed by taking into account the effect of ambipolar diffusion. The experimental results are found to have a better agreement with the present theory.

The current density has been observed to increase significantly by inserting ($\sim$ 5mm) the copper cathode inside the duct. Such an arrangement enhances the possibility of seed deposition on the cathode surface. This seed deposited cathode has been observed to give current densities around 500 A/m^2 in the diffusive mode of current conduction after a critical cathode temperature of $1050^{o}K$ which can be attributed to thermionic emission of electrons from the cathode. The work function of

the composite cathode surface formed with seed deposition has been evaluated from the experimental current-cathode temperature characteristics and is 2.04 eV. The theoretical model developed earlier is modified to include the thermionic emission of electrons from the cathode surface and has a reasonable agreement with the experimental results.

To further increase the current densities, experiments are performed with matrix type copper cathode containing multiple sharp points on its surface. These electrodes (inserted inside the duct) sustain high current densities, upto 1500 A/m^2 in diffusive mode of current conduction which can be attributed to increased thermionic emission of electrons due to the presence of high electric fields (Schottky effect) at the sharp points of the seed deposited copper cathode.

The overall conclusion of the present thesis is that seed deposited matrix type copper cathode, by virtue of its lower work function, gives appreciably high current densities in the diffusive mode of current conduction. This has a possibility to enhance the life of the electrodes, in a practical MHD generator, which would have otherwise eroded quite fast in the arcing mode of operation.

CONTENTS