Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Numerical Study of the Buoyancy-Driven Flow in a Four-Electrode Rectangular Electrochemical Cell ZHANYU SUN, VADIM AGAFONOV, CATHERINE RICE, JACOB BINDLER, MET Tech. Inc. — Two-dimensional numerical simulation is done on the buoyancy-driven flow in a four-electrode rectangular electrochemical cell. Two kinds of electrode layouts, the anode-cathode-cathode-anode (ACCA) and the cathode-anode-anode-cathode (CAAC) layouts, are studied. In the ACCA layout, the two anodes are placed close to the channel outlets while the two cathodes are located between the two anodes. The CAAC layout can be converted from the ACCA layout by applying higher electric potential on the two middle electrodes. Density gradient was generated by the electrodic reaction $I_3^- + 2e^- = 3I^-$. When the electrochemical cell is accelerated axially, buoyancy-driven flow occurs. In our model, electro-neutrality is assumed except at the electrodes. The Navier-Stokes equations with the Boussinesq approximation and the Nernst-Planck equations are employed to model the momentum and mass transports, respectively. It is found that under a given axial acceleration, the electrolyte density between the two middle electrodes determines the bulk flow through the electrochemical cell. The cathodic current difference is found to be able to measure the applied acceleration. Other important electro-hydrodynamic characteristics are also discussed.

Zhanyu Sun
MET Tech. Inc.

Date submitted: 11 Aug 2009 Electronic form version 1.4