Abstract Submitted
for the GEC20 Meeting of
The American Physical Society

A New Potential Gauge to Introduce the Electromagnetic Wave Effect into Fluid Plasma Simulations SATHYA GANTA, XIAOPU LI, DIKSHITULU KALLURI, KALLOL BERA, SHAHID RAUF, Applied Materials, Inc. — Most fluid plasma simulations employ electrostatic Poisson equation for obtaining the electric field due to charge distribution along with continuity equations for calculating all the species densities and an energy equation for updating absorbed energy by electrons. Single frequency electromagnetic waves have a spatial field variation that can be attributed to two different effects: i) electrostatic effect which is responsible for field variation between electrodes having dissimilar potentials; ii) electromagnetic wave effect which is responsible for field variation over dimensions comparable to wavelength. Plasma simulations that only include the Poisson equation consider the electrostatic effect but ignore the electromagnetic wave effect assuming that the plasma reactor dimensions are much smaller than the radio frequency wavelength. In this paper, we propose a new potential gauge with the same scalar potential as the electrostatic solution of the Poisson equations. The magnetic vector potential obtained using this new potential gauge is a direct indicator of electromagnetic wave effect. This potential gauge is built such that the electrostatic effect and electromagnetic wave effect are effectively divided between the scalar potential and the vector potential respectively. Electromagnetic solvers that employ this gauge can be used to study large area capacitively coupled plasma (CCP) reactors where the radial variation of plasma density within process gap can be significant due to the electromagnetic standing wave effect.

Sathya Ganta
Applied Materials, Inc.

Date submitted: 12 Jun 2020 Electronic form version 1.4