A plasma discharge model of a microwave plasma diamond CVD reactor

Pushpa Mahalingam[1] and David S. Dandy
Department of Chemical Engineering
Colorado State University
Fort Collins, Colorado 80523

Abstract

A self-consistent electromagnetic field model and a fluid plasma model have been developed for a microwave plasma reactor used for diamond chemical vapor deposition. The coupled numerical models simulate the electromagnetic excitation of the hydrogen discharge and the hydrogen plasma discharge characteristics. The time-varying electric and magnetic fields inside the reactor, both inside and outside the plasma discharge region, are obtained by applying a finite-difference time-domain method to solve Maxwell's equations. The electromagnetic field interactions with the plasma discharge are described using electron and ion momentum transport equations. The plasma discharge characteristics are simulated using a fluid plasma model which solves the electron and ion continuity equations, electron energy balance equation, and the Poisson equation. Simulations have been performed to study the effect of input power and pressure on hydrogen discharge characteristics such as the electron temperature and plasma density.