Title: Improving Heating Uniformity by Parameter Optimization of a Stationary Electro-Thermal Model

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The heating pattern in microwave processing of different materials depends in a very complicated manner on electromagnetic, thermal and processing parameters like permittivity, loss tangent, electrical conductivity, penetration depth, specific heat capacity, emissivity, density, diffusivity, temperature of processing, geometry, power etc. Measuring heating patterns often provide overall effects, and it is difficult to isolate and control the contributions of these critical parameters, which also vary with temperature and frequency. In this paper an analytical model has been proposed to find optimal settings of these parameters to achieve a more uniform relative heating homogeneity. To this end, this model that shows a “natural” order in temperature homogeneity may be very significant.

The method involves the calculation of the temperature profiles for a wide variety of materials using a stationary electrothermal heating model obtained by the solution of Helmholtz´s equations and the non-linear inhomogeneous heat equation imposing idealized homogenous electric field at the boundaries. The normalized variance is calculated as a measure of heating uniformity. The results drawn were used to determine the parameters with largest and smallest effect on this response variable (normalized variance) and hence the optimised model. This model demands less time and computational efforts compared to FDTD techniques. Uniform microwave heating for the optimised parameters are finally verified using the FDTD THESIS 3D code.