Abstracts

Complete FDTD analysis of microwave heating processes in frequency-dependent and temperature-dependent media

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It Is well known that the temperature rise in a material modifies its physical properties and, particularly, its dielectric permittivity. The dissipated electromagnetic power involved in microwave heating processes depending on /spl epsi/(/spl omega/), the electrical characteristics of the heated media must vary with the temperature to achieve realistic simulations. In this paper, we present a fast and accurate algorithm allowing, through a combined electromagnetic and thermal procedure, to take into account the influence of the temperature on the electrical properties of materials. First, the temperature dependence of the complex permittivity ruled by a Debye relaxation equation is investigated, and a realistic model is proposed and validated. Then, a frequency-dependent finite-differences time-domain ((FD)/sup 2/TD) method is used to assess the instantaneous electromagnetic power lost by dielectric hysteresis. Within the same iteration, a time-scaled form of the heat transfer equation allows one to calculate the temperature distribution in the heated medium and then to correct the dielectric properties of the material using the proposed model. These new characteristics will be taken into account by the EM solver at the next iteration. This combined algorithm allows a significant reduction of computation time. An application to a microwave oven is proposed.

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