Modeling-Based Synthesis of a Microwave Heating Process Resulting in a Uniform Temperature Field

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A fundamental problem of microwave thermal processing is the intrinsic non-uniformity of internal heating of a dielectric load. This talk outlines a modeling-based technique for solving this problem and provides a general description of the developed computational tools which utilize the *QuickWave-3D* software package. The proposed technique is based on (*i*) approximating the solution to a coupled electromagnetic-thermal problem with temperature-dependent material parameters, (*ii*) a novel measure for the uniformity of microwave-induced temperature fields, and (*iii*) the perception of heat diffusion as a vital mechanism in achieving uniformity of heating..

The developed optimization procedure utilizes two specially designed routines which determine the set of proper design variables and synthesize the optimal heating sequence. Design variables are chosen using the idea of complementary heating patterns based on extensive *QuickWave-3D* modeling. The software developed to synthesize the optimal heating sequence along with the resulting uniform 3D temperature field is based on the algorithm shown in Fig. 1. In an iterative fashion until the heating goals are achieved, the optimization software simulates microwave heating for a fixed amount of time using the set of model parameters which produce the most uniform temperature field for the load. Relaxation is initiated whenever additional heating results in the maximum load temperature exceeding the prescribed threshold value. The functionality of the technique is illustrated by computational experiments providing reduction of time-to-uniformity compared to the pulsing regime by 4 to 9 times.

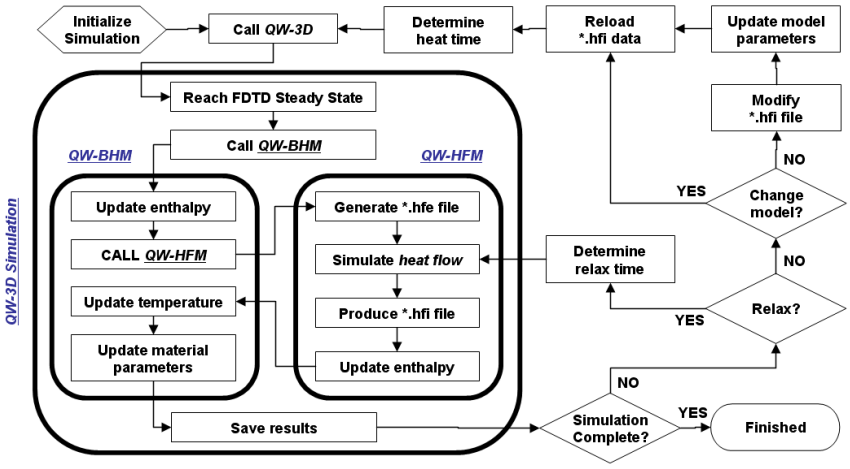

Fig. 1. A flow-chart of the software analyzing the processes with variable parameters and pulsing microwave energy.