HOMOGENEOUS DIELECTRIC HEATING IN LARGE MICROWAVE OVENS BY EXCITATION OF MULTIPLE EIGENMODES AT THEIR RESONANCE FREQUENCIES

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The proper use of microwave heating can significantly increase the production cycle time and energy efficiency in industrial heating processes compared to conventional heating methods. The main challenge of this technique is to improve the temperature uniformity in the product exposed to standing waves inside the microwave oven. In opposite to the magnetron, solid-state amplifiers (SSA) offer the possibility to increase the homogeneity by changing the amplitude, frequency and phase with the help of intelligent control methods [1]. In this work, the variation of the frequency and the amplitude of the SSA is considered. The multimode microwave oven used in the experiment has an industrial size of 535 mm x 510 mm x 395 mm (Figure 1). The SSA was operated in the frequency range from 2.4 GHz to 2.5 GHz. It consisted of a new 300 W solid state microwave source from HBH microwave GmbH, Germany. An antenna system was developed based on numerical simulation with CST Microwave Studio. The positions of four loop antennas were optimized to excite at least 90 % of the possible 32 eigenmodes [2] of the unloaded cavity. At the roof of the cavity, an IR camera was installed to observe the temperature distribution of the load during heating. A sheet of paper was used as the thermal load. It was placed on a PTFE plate as a sample holder. Figure 1 exemplary illustrates the comparison of the simulated power distribution with the measured temperature distribution for two representative eigenmodes. As can be expected from the figures, an optimized combination of different modes will lead to a significantly improved temperature uniformity in the material. Latest results obtained with different type of loads will be presented.

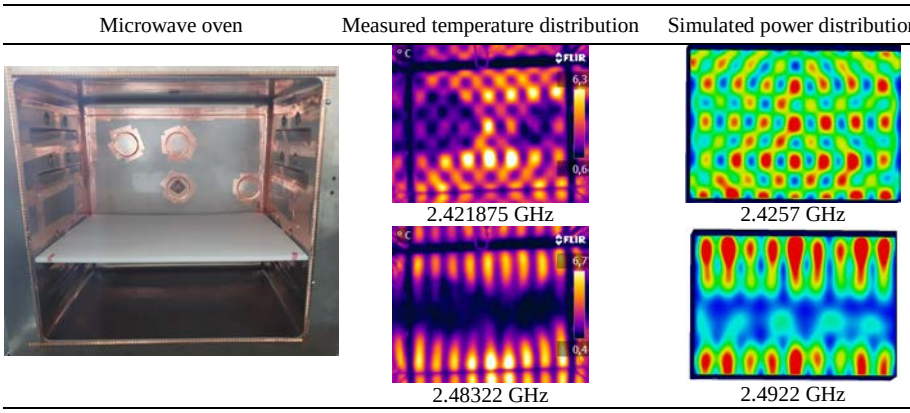

Figure 1. Microwave applicator (left) and comparison of simulated with measured modes.

References

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