Genetic Algorithms Optimization of Dielectric Casts for Uniform Electric Field Pattern Synthesis

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One of the most important and desired features of microwave-heating ovens is uniformity of electric field distribution across the material to be heated since the final quality of the heating process depends on it [1-3].

Different methods have been used in order to obtain uniform heating patterns such as turning trays in domestic ovens [4], mode stirrers [5-6] or multi-feeding techniques [7]. Other authors have proposed the use of intelligent sample movement within the applicator in order to obtain uniform heating patterns [8].

However, traditional techniques, such as mode stirrers or turning trays are not able of providing uniform heating for high loss materials [5-6, 8]. Therefore, an alternative technique for achieving this uniform heating must be searched for such lossy dielectric materials.

In this work, we present a new technique for achieving electric field uniform patterns in multimode microwave-heating ovens for high loss materials. The simulated product is clay with relative permittivity ε_r=24.64-*j*5.45. The problem to be solved consists of a 24×24×24 cm3 metallic rectangular applicator. The multimode oven is fed by means of a WR340 waveguide centered at the upper wall of the oven and excited with the TE_{10} mode around 2.45 GHz ISM frequency.

In this case Genetic Algorithms are used to obtain the optimum design in terms of uniformity which in this case implies designing the dimensions and permittivity of the dielectric casts around the sample. The evaluation function used in this work involves the typical deviation of the electric field in the sample surface normalized by the average value of the electric field strength in the sample.

From obtained results it can be concluded that this technique can obtain uniform electric field patterns even for high loss materials. Experimental validation is also provided in order to confirm that the introduction of dielectric casts are able to change electric field patterns in the cavity.

References

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