Electromagnetic(EM) And Thermal Characterization Of A Microwave Oven In COMSOL Multiphysics® Software

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Introduction: Chemical reactions performed under microwave irradiation often have high reaction rates and high selectivities, which enable reactor sizes to be compact and processes to be energy-conserving. A microwave oven is widely used for microwave chemical processing and chemical synthesis. COMSOL Multiphics was performed to obtain the the distribution of the electromagnetic (EM) field in the multi-mode applicator and the rotating stirrer fan of the microwave oven. The temperature distribution of the sample in the microwave oven was also obtained.

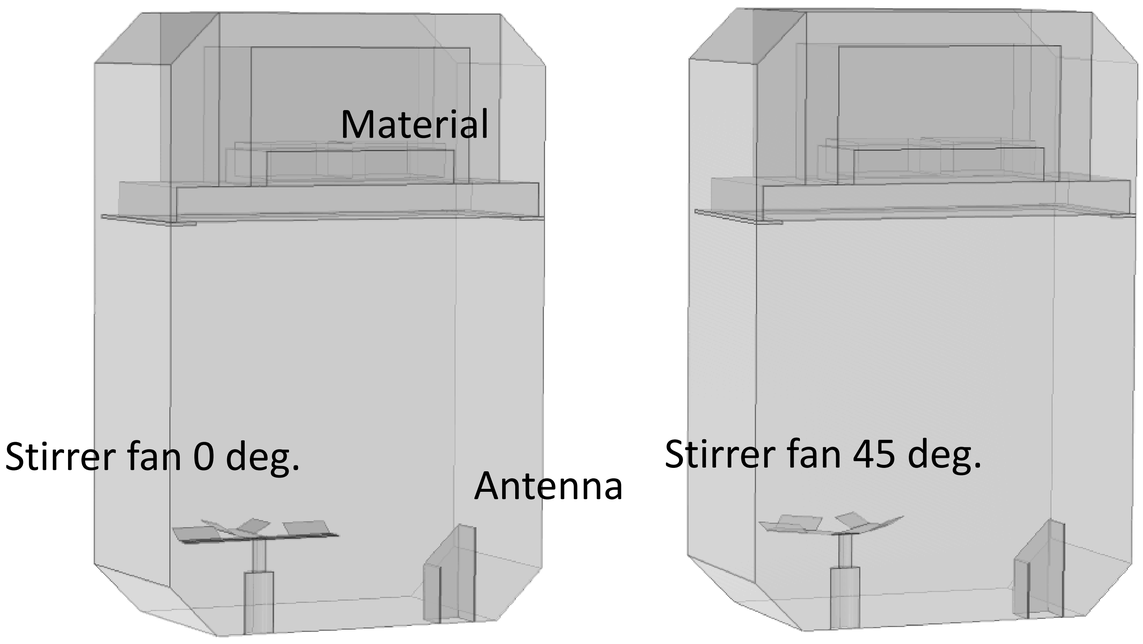

Figure 1. Model of the microwave oven

Computational Methods:

(1) Maxwell Eq.

$$\nabla \bullet E = \frac{\rho}{\varepsilon}$$

$$\nabla \bullet \overline{B} = 0$$

$$\nabla \times E = -\frac{\partial B}{\partial t}$$

$$c^2 \nabla \times B = \frac{\partial E}{\partial t} + \frac{J}{\varepsilon}$$

(2) Heat Transfer Eq.

$$\rho c_0 \frac{\partial T}{\partial t} - \nabla \mathrm{k} \nabla T = Q$$

Because of slow rotation of the stirrer fan, we carried out two calculation: zero and 45 deg. angle of the stirrer fan in Fig. 1 and these results were averaged as the rotation results.

Results: Fig. 2 shows the result of EM simulation. And Fig. 3 also shows the result of Heat Transfer simulation.

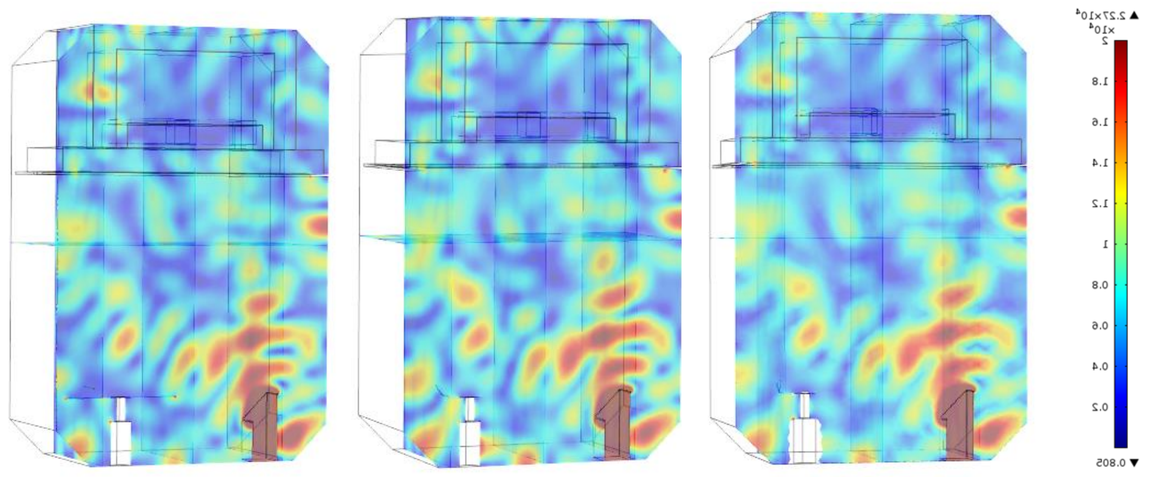

Figure 2. Electro magnetic field in the multi mode applicator;(a)the stirrer fan with 0 deg. (b) with 45 deg. (c)average of both results

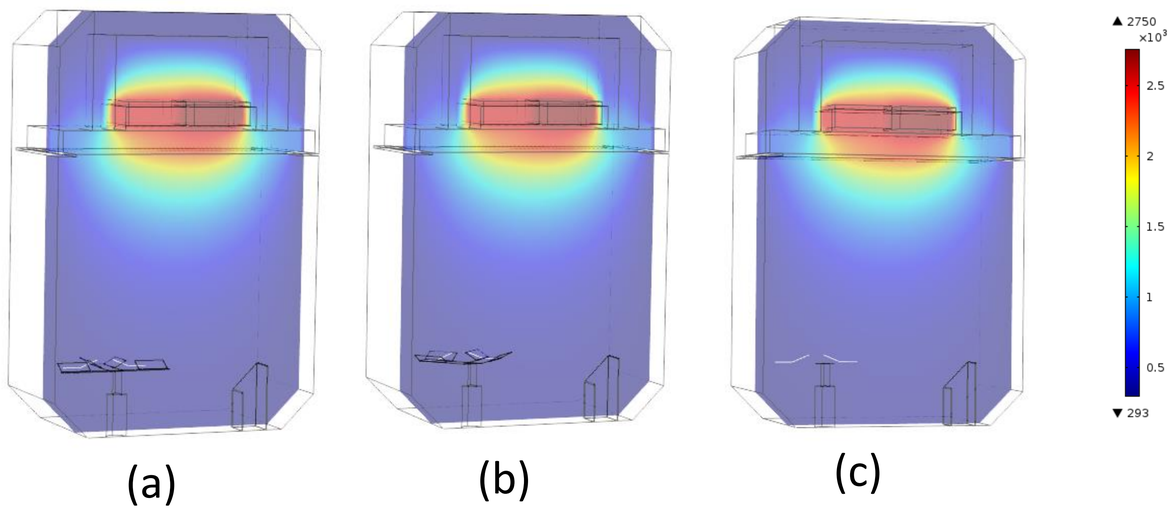

Figure 3. Temperature distribution in the multi mode applicator;(a)the stirrer fan with 0 deg. (b)with 45 deg. (c)average of both results

Conclusions: We performed simulation of EM and heat transfer the microwave oven with rotating the stirrer fan. The result was obtained by averaging the results of calculation of two angle stirrer fan.

References:

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2. Y. Wada, S. Fujii, et al Refining Magnesium Metal using a Microwave Pidgeon Method, *Nature*, to be submitted