

Low Temperature Microwave Treatment of Sphere Materials

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Abstract

Microwave heating has many advantages over the traditional heating method, such as needing shorter time, saving more energy, and being easier to control. But there still are some problems.(1) Thermal runaway still exists because the reflection and absorption of microwave by the reactants change nonlinearly with time during the reaction. It may destroy the microwave generator and burn the reactants, even lead to an explosion. (Santos,2011); (2) Hot spot due to the microwave's inhomogeneous heating(Horikoshi et al.,2011); (3) Cylinder and sphere is more prone to having overheating in the central place caused by microwave focusing effect, or even an explosion, and the size of sample also has an important influence on distribution within the heated material under microwave field intensity.

The carousel, or turntable, is one of the earliest and the most intuitive methods of increasing temperature uniformity inside a microwave oven. Microwave ovens heat food volumetrically by electromagnetic radiation. The process of microwave heating of foods has been extensively studied, both experimentally (Nott & Ohkawa, 1978). Others solution is installing metal blades Driven by a motor on the top of the microwave cavity. It is called field mixer.(Y Huang et al.,2005).

We use the multi-physical field analysis software COMSOL Multiphysics® software based on finite element method to simulate the different states of spherical potatoes numerical simulation, through the electromagnetic interface and the heat transfer interface calculated temperature distribution in the different states of spherical potatoes, then verified by experiments, by thermal infrared imaging system and optical fiber thermometer measured the experimental results and the comparison of the simulation results to verify the rationality and accuracy of model. The results from the simulation can be drawn, under the same volume, have and without ice shell on the impact of microwave heating is very large, through proper freezing can not only improve the efficiency of microwave heating, but also effectively improve the uniformity of microwave heating and reduce the focusing effect of microwave on circular materials.

The simulation results indicated that the low temperature can improve the microwave heating uniformity greatly. It has some guiding significance for the future focus of the spherical.

Reference

- (1) Miura et al., 2004; Omar et al., 2011; Ruan et al., 2011, 2007; Honglei Zhang et al., 2012).
- (2) Santos, 2011.
- (3) Horikoshi et al., 2011.
- (4) Nott & Ohkawa, 1978.
- (5) Y Huang et al., 2005.