

催化、动力学与反应器

微波化学反应器与实验结果的重复性

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摘要 对基于家用微波炉改装的微波化学反应器建立模型,用有限元方法联合求解麦克斯韦方程和热传导方程并考虑了介电常数随温度和时间的变化,得到烧杯中溶液的温度分布。计算发现烧杯在反应器腔体中摆放的位置对加热效果有着显著影响。而化学反应是一个非平衡体系,这种位置差异带来的影响会更加明显。通过实验进一步验证了以上结论,并且发现:由于反应器磁控管的不稳定性,即使烧杯位于相同位置,多次实验的结果也不相同。因此,基于家用微波炉改装的微波化学反应器很难保证微波化学实验的重复性。

关键词 [微波化学](#); [反应器](#); [重复性](#); [微波加热](#)

分类号

Microwave reactor and repeatability of experiments

Abstract

Many microwave reactors widely used in laboratory are made from commercial microwave ovens. In this paper, the heating process inside the reactor was simulated in order to obtain the final temperature distribution in the solution in a beaker. Maxwell's equations and the heat transport equation (HTE) were coupled to calculate the temperature results by means of the finite element method (FEM). In the calculation, Debye's equation and Huang's method were used to describe the temperature and time dependence of dielectric properties. Due to the non-uniform distribution of fields in the cavity, the heating results varied significantly with the position of the beaker. This could be more obvious for a chemical reaction because of the non-equilibrium characteristics. It was also observed that the repeatability of experiments was poor even for a fixed position of the beaker due to the magnetron instability. Therefore, such chemical reactors made from commercial microwave ovens can hardly ensure the repeatability of experiments. It was observed that the repeatability of experiments is poor even for a fixed position due to the magnetron's instability. Therefore, such chemical reactors made from commercial microwave ovens can hardly ensure the repeatability of experiments.

Key words [microwave chemistry](#); [reactor](#); [repeatability](#); [microwave heating](#)

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