

磁流体在交变磁场中的热效应

The Heat Effect of Magnetic Fluid Under an Alternating Magnetic Field

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中文摘要:

以大豆卵磷脂为表面活性剂制备 Fe_3O_4 平均粒径为20 nm的磁流体, 在10 kW, 100 kHz的磁场中研究该磁流体的热效应. 用温度计测量不同 Fe_3O_4 含量的水、琼脂的温度变化值, 探讨 Fe_3O_4 含量和介质对温度的影响, 为磁流体用于肿瘤热疗提供实验依据. 实验结果表明, 脂质磁流体在交变磁场作用下使周围升温, 升温速度及平稳时的温度和 Fe_3O_4 的含量、磁场强度及周围介质有关, 含量高, 场强大, 平稳温度值高, 介质流动性好, 加快热传递, 升温快. 通过调节磁场强度和磁流体的量可达到所需温度值.

英文摘要:

Magnetic fluid was made of Fe_3O_4 particles and soybean lecithin which was only 20 nm in diameter. The heat effect was studied under 10 kW, 100 kHz magnetic field. The temperature change was measured by a glass thermometer ($\pm 0.1^\circ\text{C}$) in agarose gel and distilled water with different Fe_3O_4 content respectively. The effect of magnetic intensity was discussed. This was an experimental basis for hyperthermia treatment of tumors. The results indicated that the temperature raised quickly as the increase of Fe_3O_4 concentrations and the magnetic field intensity. The temperature finally remained constant due to the balance of heat generation and heat transfer to the surroundings. When Fe_3O_4 concentrations were 1 g/L and 2 g/L, the balance temperature were respectively 41.9°C and 47.5°C as the magnetic field was 2.78×10^4 A/m. In 1 g/L Fe_3O_4 concentration, the magnetic field intensity were 2.78×10^4 A/m and 1.11×10^4 A/m, the temperature plateaus were at 41.9°C and 30.7°C respectively. The heat transfer faster in water than in agarose gel.

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