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Effect of ferrofluid temperature and container fill level on vibration energy harvesting

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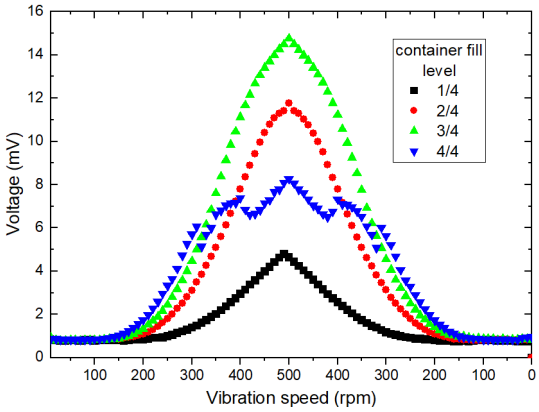
Energy harvesting is of great importance in the current era of big data when powering of numerous distributed sensors must be solved. The integration of wearable electronics in practise strengthens the importance of portable and sustainable power supplies. In this paper we study energy harvesting by magnetized ferrofluid sloshing inside a cylindrical container excited by a laboratory shaker. The ferrofluid is based on low-viscous transformer oil with iron oxide nanoparticles coated with oleic acid. Electrical energy is harvested via electromagnetic induction in a coil wound around the container. Three coils of various induction and resistance are included in the study to assess the optimal design of the generator. The induced voltage is measured under increasing and decreasing shaking rates (max. 500 rpm) by means of a digital oscilloscope. Four container fill levels are analysed from energy conversion point of view. The experiments are performed at various ferrofluid temperatures. It is found that 3/4 filling level is the most effective, yielding the highest electromotive force up to 15 mV on 50 Ω resistor. A slight ferrofluid temperature increase (0.5 ℃) during one sloshing cycle is attributed to viscous dissipation and magnetic relaxations. The effect of ferrofluid temperature on the energy harvesting is correlated with temperature-dependent magnetization measurements. Ferrofluid kinetic energy approach is applied in calculations of the energy conversion efficiency. The obtained results suggest promising ferrofluid applications in self-powering technique.



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