Rapid demagnetization of Suction Casting Alloy cores for Energy Harvesting

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Energy Harvesting is mainly associated with transformation of different sources of energy commonly found in the environment, which are undesirable and usually suppressed, (e.g. noise, mechanical vibrations, heat etc.), or widely available (e.g. sunlight, wave energy, biochemical processes) to useful electric energy [1]. One type of such transformation base on immediate demagnetization of the magnet by a stroke following an explosion or other strong impulse of force. During this demagnetization magnet loses its magnetic properties and generates huge magnetic field impulse around it, which allows to charge high voltage capacitors with large capacity. From the past few years this issue is of great interest in military applications [2].

The paper presents the results obtained using the rapid demagnetization method in the case of a NdFeB magnet and new hybrid core. The developed core consisted of three basic elements: a NdFeB magnet, Terfenol-D and a developed metallic alloy prepared with a suction casting method. The main goal of proposing a new type of core in the event of rapid demagnetization is to partially replace the permanent magnet with another material in order to reduce the rare-earth material, while keeping the amount of generated electricity at a level that allows powering low-power electrical devices. To "capture" rapid change of magnetic flux a small number of coils around the core was made. However, a very low voltage level at a very high current required the use of specialized electronic transducers capable of delivering the appropriate voltage level to power the microprocessor system. To overcome this problem the circuit designed by authors which enabled voltage processing from low impedance magnetic circuits was used. The obtained results demonstrated the usefulness of the system to resonant frequencies up to 1MHz.

It should be noted that the estimated efficiency of transforming the impact energy and demagnetization of the core to electric current was only 0.01%. Therefore, the key challenge is to improve the energy transformation, which might be done by changes of core arrangement or harvester construction.

References:

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This research was funded by The National Centre for Research and Development within the project: "Composite magnetostrictive-nanocrystalline materials for use in the field of energy harvesting and transformation" grant number LIDER / 21/0082 / L-9/17 / NCBR / 2018