

Recycling of End Of life rare-earth permanent magnets

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The increasing efforts towards a greener and more sustainable future has significantly enhanced the demand for permanent magnets based on rare-earth elements, which are key components of environmentally friendly energy technologies, such as hybrid and electric vehicles and wind turbines [1]. To respond to this growing demand and to cope with the Chinese monopoly [2] of the production and treatment of rare earth elements, the recycling and reuse of End-of-Life (EoL) permanent magnets represents a necessary but still little practiced solution as only 1% of EoL magnets are currently reused.

The present contribution aims at presenting the general scheme of an efficient and sustainable route we are developing to fabricate bonded PMs from NdFeB EoL products by using processes with reduced or null environmental impact with respect to the production of new magnets. The strategy includes three main steps: i) pulverization of EoL NdFeB PMs to obtain powders with sub-mm sizes preserving original magnetic properties, ii) preparation of filaments for 3D printing consisting of a biodegradable polymeric matrix containing a homogeneous dispersion of EoL NdFeB magnetic powders, iii) fabrication of new bonded PMs by using a customized 3D-printer that allows applying a magnetic field during the printing process for the fabrication of anisotropic magnets with superior properties. The plan is to reuse magnets from electric motors (0.1 to 1 kg) as their weight and size make them easy to handle and the whole process can be optimized in research laboratories.

The results are expected to lay the scientific and technical foundations for the development of a circular economy of rare-earth-based permanent magnets, which would reduce the geopolitical risk of supply of raw materials, decrease the environmental impact of rare-earth industry, while fostering the transition to a greener and more sustainable future.

References:

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- [2] J. M. D. Coey, Engineering 6(2020)119.