Optimisation d'un procédé de recyclage d'aimants Nd-Fe-B

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Abstract

According to their excellent magnetic properties, Nd-Fe-B magnets are increasingly used in technologies related to energy conversion. However, their production requires the extraction of rare earths, a step which causes a high environmental risk linked to the discharge of large quantities of both toxic wastewater and radioactive waste. From this point of view, recycling Nd-Fe-B magnets constitutes a good strategy for producing new magnets. In this context, a hydro/solvothermal pulverization process devoted to the recycling of Nd-Fe-B magnets was optimized depending on the nature of the solvent, the treatment time, and the particle size of the previously crushed magnet. The results showed that a solvothermal treatment in ethanol for 30 minutes makes it possible to pulverize the magnet to be recycled without degrading the Nd2Fe14B magnetic phase, and this for different sizes of particles from the previously crushed magnet. Powders obtained according to the optimized process were sintered at 900°C by SPS (Spark Plasma Sintering). The application of a pressure of 75 MPa and the mixing with commercial Nd-Fe-B powder made it possible to minimize the degradation of the Nd2Fe14B magnetic phase during sintering. The sintering at 750°C of powders made up of polycrystalline particles from a magnet to be recycled takes advantage of the initial magnetic orientation, which could allow obtaining a recycled magnet with a high coercivity. Post-sintering annealing at 750°C for 30 minutes under vacuum improves the magnetic properties of the materials obtained. Finally, a single-phase powder, consisting solely of Nd2Fe14B phase particles, was successfully obtained by solvothermal pulverization a Nd-Fe-B magnet followed by a reduction-diffusion treatment of calcium hydride CaH2.