Hot deformed Nd-Fe-B magnets with additions of Nd-Cu-Zn alloy by spark plasma sintering technique

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The anisotropic hot-deformed (HDed) RE-Fe-B magnets have attracted much attention for their remarkable magnetic properties and broadening various applications due to the ultrafine grained microstructure. Hot deformation usually consists of two steps, hot pressing and die upsetting. During HD process, the initially isotropic $Nd_2Fe_{14}B$ nanocrystals in melt-spun flakes transformed to closely stacked laterally elongated grains with the crystallographic *c*-axis parallel to the pressing direction during the DU process, which gives rise to high remanence and energy product, together with exceptional corrosion resistance, thermal stability, and fracture toughness. The spark plasma sintering (SPS) technique has been widely concerned as a new pressure sintering process to consolidate Nd-Fe-B powders to full density at relatively lower temperatures in a short period of time which generates plasma uniform heat the materials and inhibits the grain growth. HDed Nd-Fe-B compact with nanocrystallite texture has been successfully fabricated by SPS and a combination of SPS and HD processes.

In order to further improve the magnetic properties, Dy compounds or low melting point eutectic alloy was applied to grain boundary diffusion coating process. However, a concerted effort was purpose to develop Dy-free high coercivity Nd-Fe-B due to the high cost of the heavy rare earth element Dy. Zn with low melting point (420 ^{o}C) has been found increase the wettability and enhance the texture formation and improve the microstructure, Further lead to the increase of remanence and coercivity. The understanding of microstructural evolution with the addition during preparation and deformation is an indispensable step toward the realization of high performance magnets.

In this work, Nd-Cu-Zn alloy was mixed with the initial MQU-F riboons. HDed Nd-Fe-B magnets were produced by SPS through the optimized method. The effects and microstructure evolution with addition on the magnetic properties hot pressing and die upsetting were discussed in our work.

Keywords: NdFeB magnets; Hot deformation; Nd-Cu-Zn; microstructure; SPS

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