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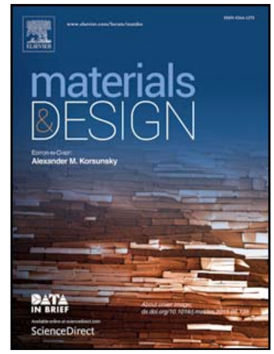

Preparing $Sm_2Fe_{17}C_x$ compound by high-energy ball-milling Sm-Fe alloy in heptane followed by annealing, re-milling and re-annealing

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Preparing $Sm_2Fe_{17}C_x$ compound by high-energy ball-milling Sm-Fe alloy in heptane followed by annealing, re-milling and re-annealing

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Abstract

In this paper, we present a new preparation method for $Sm_2Fe_{17}C_x$ compound based on solid-liquid reaction. High-energy ball-milled in heptane for 8 hours, $Sm_{25}Fe_{75}$ alloy containing $SmFe_2$, $SmFe_3$ and Sm_2Fe_{17} phases disproportionates into $SmH_{2+\delta}$, α-Fe, Fe_3C and graphite. H and C atoms come from heptane. Annealed to 850 ℃ under vacuum, $SmH_{2+\delta}$ decomposes and Sm-C, $Sm_2Fe_{14}C$, α-Fe are formed. Re-milling for 1.5 hours in argon and re-annealing at 600 ℃ for 15 minutes promotes the transformation of partial $Sm_2Fe_{14}C$ to $Sm_2Fe_{17}C_x$ (x: 0.3-1.5) and the formation of nanoscale microstructure. Due to the intergrain exchange coupling between magnetically hard $Sm_2Fe_{17}C_x$ and soft $Sm_2Fe_{14}C$/α-Fe, the product behaves like magnet with single magnetically hard phase. Maximum coercivity of 4.4 kOe is obtained. Shorter ball-milling time (6 hours) results in the insufficiency of α-Fe and Fe_3C, limiting the formation of $Sm_2Fe_{14}C$ and the transformation of $Sm_2Fe_{14}C$ to $Sm_2Fe_{17}C_x$. Longer ball-milling time (10 hours) results in excess of α-Fe in the final product. Both cases reduce the ratio of magnetically hard phase to soft one in the nanocomposite magnet, resulting in the decrease of coercivity.

Keywords: $Sm_2Fe_{17}C_x$; high-energy ball-milling; heptane; coercivity

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