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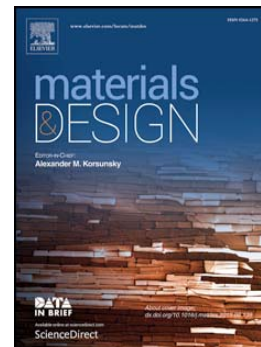
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Preparing  $\text{Sm}_2\text{Fe}_{17}\text{C}_x$  compound by high-energy ball-milling Sm-Fe alloy  
in heptane followed by annealing, re-milling and re-annealing

Hongmin Geng, Yuan Ji, Xueyuan Feng, Jingjing Zhang, Yuchao Gao, Yu Yan, Wenquan Wang,

Feng Su, Xiaobo Du<sup>1</sup>

*Key Laboratory of Physics and Technology for Advanced Batteries (Ministry of Education),*

*College of Physics, Jilin University, Changchun 130012, PR China*

**Abstract**

In this paper, we present a new preparation method for  $\text{Sm}_2\text{Fe}_{17}\text{C}_x$  compound based on solid-liquid reaction. High-energy ball-milled in heptane for 8 hours,  $\text{Sm}_{25}\text{Fe}_{75}$  alloy containing  $\text{SmFe}_2$ ,  $\text{SmFe}_3$  and  $\text{Sm}_2\text{Fe}_{17}$  phases disproportionates into  $\text{SmH}_{2+\delta}$ ,  $\alpha\text{-Fe}$ ,  $\text{Fe}_3\text{C}$  and graphite. H and C atoms come from heptane. Annealed to 850 °C under vacuum,  $\text{SmH}_{2+\delta}$  decomposes and Sm-C,  $\text{Sm}_2\text{Fe}_{14}\text{C}$ ,  $\alpha\text{-Fe}$  are formed. Re-milling for 1.5 hours in argon and re-annealing at 600 °C for 15 minutes promotes the transformation of partial  $\text{Sm}_2\text{Fe}_{14}\text{C}$  to  $\text{Sm}_2\text{Fe}_{17}\text{C}_x$  ( $x$ : 0.3-1.5) and the formation of nanoscale microstructure. Due to the intergrain exchange coupling between magnetically hard  $\text{Sm}_2\text{Fe}_{17}\text{C}_x$  and soft  $\text{Sm}_2\text{Fe}_{14}\text{C}/\alpha\text{-Fe}$ , 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  $\alpha\text{-Fe}$  and  $\text{Fe}_3\text{C}$ , limiting the formation of  $\text{Sm}_2\text{Fe}_{14}\text{C}$  and the transformation of  $\text{Sm}_2\text{Fe}_{14}\text{C}$  to  $\text{Sm}_2\text{Fe}_{17}\text{C}_x$ . Longer ball-milling time (10 hours) results in excess of  $\alpha\text{-Fe}$  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:**  $\text{Sm}_2\text{Fe}_{17}\text{C}_x$ ; high-energy ball-milling; heptane; coercivity

<sup>1</sup> Corresponding author: duxb@jlu.edu.cn

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