



低温還元拡散による TbCu₇ 型 Sm-Fe 磁粉の合成

Jungryang KIM
産業技術総合研究所

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1. 背景と研究目的

TbCu₇-type Sm-Fe-N with a large saturation magnetization in the iron-rich composition has been reported: a (Sm-Zr)(Fe-Co)₁₀N_x alloy with the TbCu₇ structure shows 1.70 T which is the largest saturation magnetization ^[1]. New reduction-diffusion (RD) process as called low-temperature RD process has been developed by our group. Normal RD process need to over 850 °C for melting Ca metal, which is a reductant. On the other hand, low-temperature RD process can conduct at lower temperature than 850 °C because introduction of molten salt decrease Ca melting point. The purpose of this study is to synthesize TbCu₇-type Sm-Fe particles by low-temperature RD process and investigate its atomic structure from synchrotron XRD patterns.

2. 実験内容

TbCu₇-type Sm-Fe particles have been synthesized by low-temperature RD process. The mixtures of FeCl₃ and SmCl₂ with LiCl and Ca as the reductants have been annealed at 600 °C for 10h under Ar atmosphere. The annealed samples have been rinsed using water to collect only magnetic particles using a magnet. Then, to remove hydrogen, which is interstitial element occurred during washing, the product annealed at 200 °C for 3h under vacuum. The synchrotron XRD ($\lambda = 0.8858 \text{ \AA}$) has been conducted at Aichi Synchrotron Radiation Center to investigate the atomic structure, especially, lattice parameter, of producing particles. The lattice parameters detected from Rietveld analysis using RIETAN-FP ^[2].

3. 結果および考察

TbCu₇-type Sm-Fe particle has been successfully synthesized by low-temperature RD process in this study as seen in figure 1, which is its synchrotron XRD pattern. From Rietveld analysis, it is clarified that α -Fe phase is $\sim 6 \text{ wt\%}$ and the lattice parameters are $a = 4.942 \text{ \AA}$ and $c = 4.175 \text{ \AA}$. The c/a is about 0.8448 which is similar to Sm_{0.67}Fe_{5.67} reference ($c/a=0.8454$) and the synthesized TbCu₇-type Sm-Fe particle in this study is SmFe_{8.5}. We need to decrease amount of α -Fe phase to get single-phase TbCu₇-type Sm-Fe particle and study its intrinsic magnetic property.

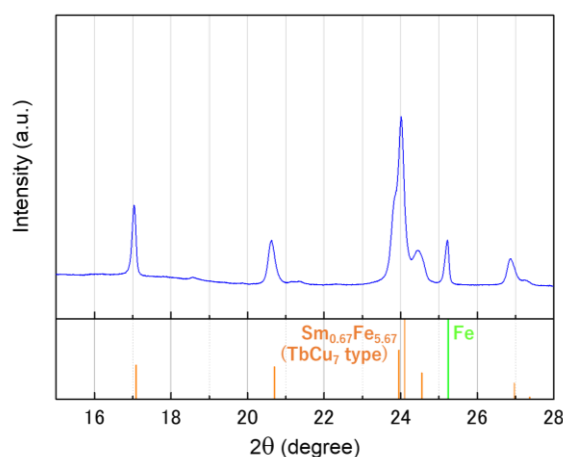


Fig.1 Synchrotron XRD patterns ($\lambda = 0.8858 \text{ \AA}$) of TbCu₇-type Sm-Fe particle

4. 参考文献

1. S. Sakurada, A. Tsutai, T. Hirai, Y. Yanagida, M. Sahashi, S. Abe and T. Kaneko, Journal of Applied Physics, 79 (1996) 4611.
2. F. Izumi and K. Momma, Solid State Phenom., 130 (2007)15–20.