

# Formation and magnetic properties of the $\text{RCo}_4\text{Si}$ compounds

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**Abstract:** We have succeeded in preparing  $\text{RCo}_4\text{Si}$  compounds ( $\text{R} = \text{Y}, \text{Nd}, \text{Pr}, \text{Sm}, \text{Gd}, \text{Tb}, \text{Dy}, \text{Ho}$  and  $\text{Er}$ ). All samples are single phase with the  $\text{CaCu}_5$  structure as revealed by X-ray analysis. Si substitution drastically reduces the Curie temperature of the host  $\text{RCo}_5$  compounds. In particular, we have observed a spontaneous magnetization of  $2.34 \mu_{\text{B}}/\text{f.u.}$  at 5 K for  $\text{SmCo}_4\text{Si}$ , which is significantly lower than the value of  $3.0 \mu_{\text{B}}/\text{f.u.}$  found for  $\text{YCo}_4\text{Si}$ . Also the temperature dependence of the spontaneous magnetization of  $\text{SmCo}_4\text{Si}$  shows ferrimagnetic characteristics. These results suggest an antiparallel coupling of the 3d and 4f moments in  $\text{SmCo}_4\text{Si}$ , which has so far not been observed in light-rare-earth-transition-metal compounds. The Co magnetocrystalline anisotropy and the crystalline electric field interaction of the compounds have been studied. The results suggest the distinctive role of Si substitution in modifying the magnetic properties of the host  $\text{RCo}_5$  compounds.

**Index Keywords:** Calcium compounds; Cobalt compounds; Crystalline materials; Magnetic anisotropy; Magnetic field effects; Magnetic moments; Magnetization; Rare earth compounds; Thermal effects; Magnetocrystalline anisotropy; Ferrimagnetic materials

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