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Sciences, Ingénierie et Environnement

Magnetic Properties of $SmFe_{8.75}Ga_{0.25}$ and its carbide

T. Bartoli, J. Moscovici and L. Bessais

ICMPE, UMR7182, CNRS–Université Paris-Est, France

Introduction

Reason behind Sm-Fe-Ga compounds:

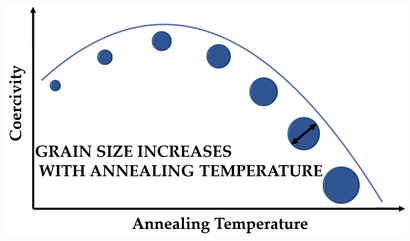
- **Sm:** High anisotropy and high magnetic moment.
- **Fe:** High transition temperature and high magnetic moment.
- **Ga:** Stability improvement and magnetic properties improvement.

$SmFe_{8.75}Ga_{0.25}$ (1/9): a meta-stable phase & precursor of $Sm_2Fe_{16.5}Ga_{0.5}$ (2/17)

- **2/17:** High magnetic moment but low T_C and planar magnetic anisotropy.
- **1/9:** Nanocrystalline-exclusive phase, with different magnetic properties.

Objectives

- Study of $SmFe_{8.75}Ga_{0.25}$: structural and magnetic properties.
- Fine-tuning of magnetic properties by altering Sm excess during synthesis.
- Enhancing the magnetic properties by carburation.
- Optimizing H_C with the annealing temperature.

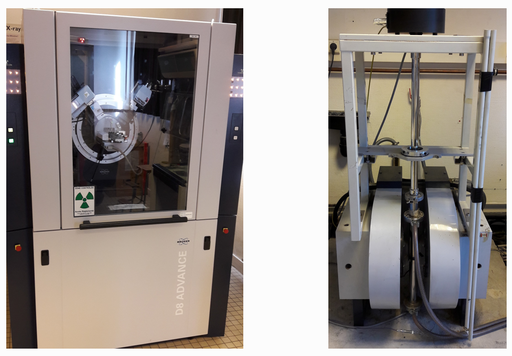


Experiment

Synthesis

Arc melting, Ball-milling & Annealing

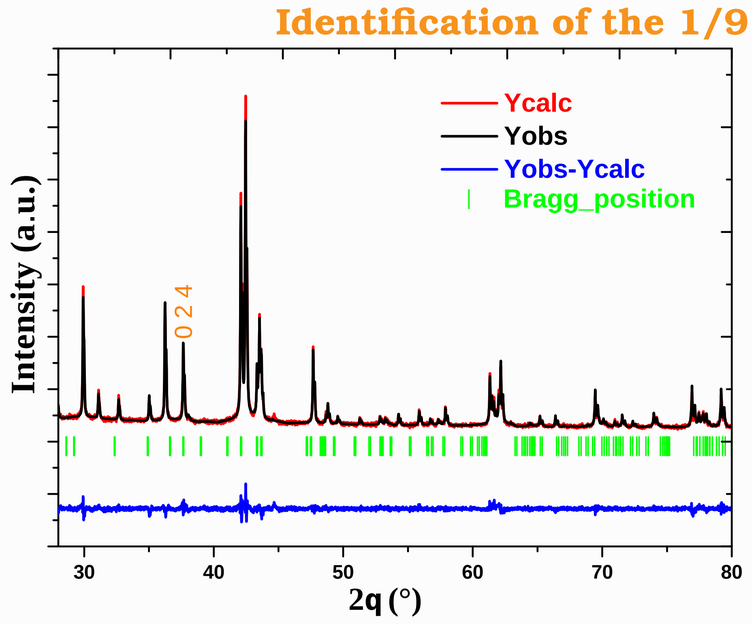
Characterization



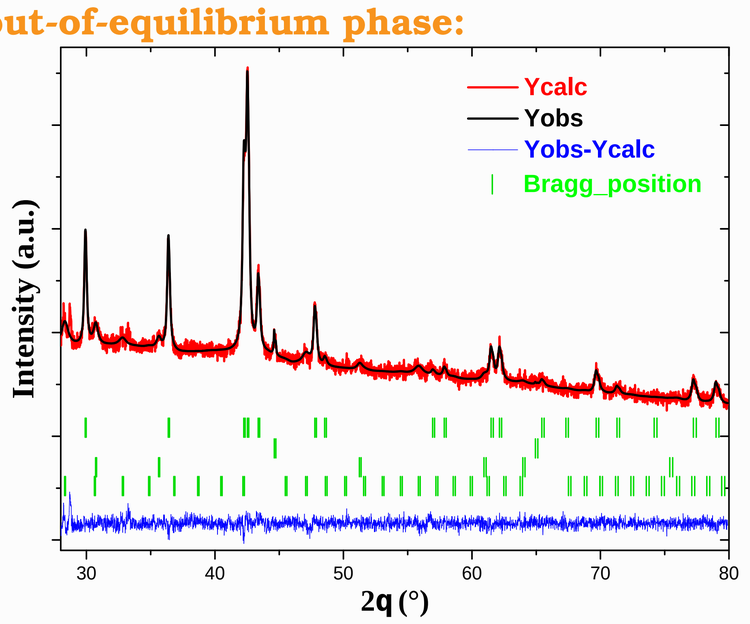
Structural & Magnetic Characterizations

Structure analysis

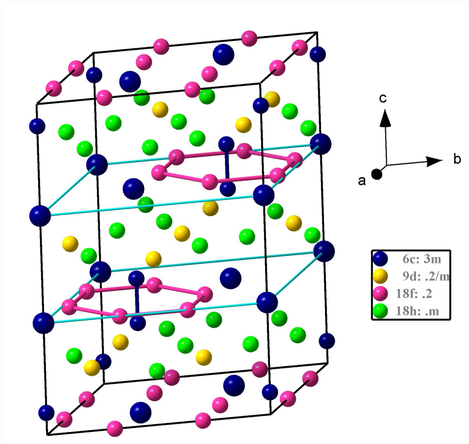
Identification of the 1/9 out-of-equilibrium phase:

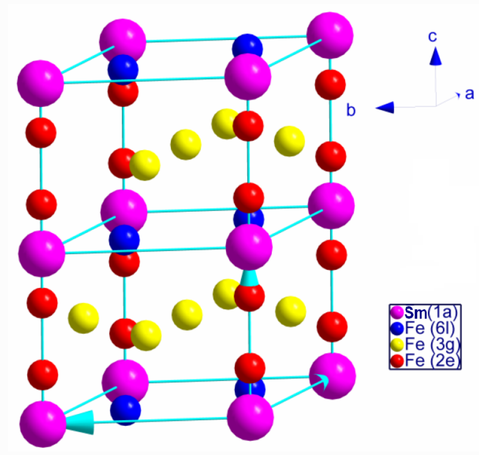


Rietveld refinement of $Sm_2(Fe,Ga)_{17}$ compound.



Rietveld refinement of $Sm(Fe,Ga)_9$ compound.

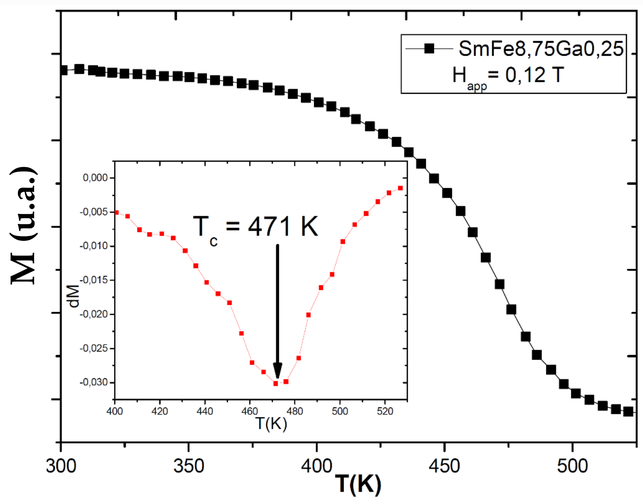




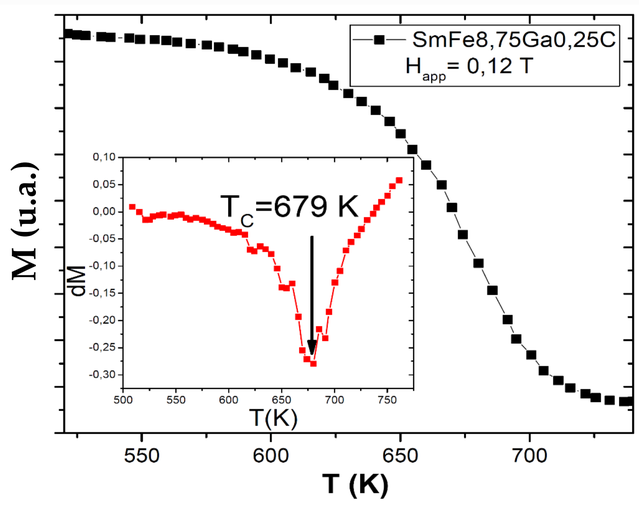
Effect of carburation on cell parameters:

cell parameter	1/9	1/9C
a (Å)	4.9351(3)	**5.0193(4)**
c (Å)	4.1716(2)	**4.2083(4)**

Magnetic properties

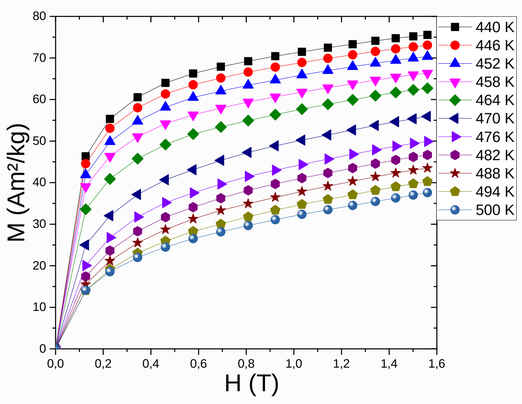


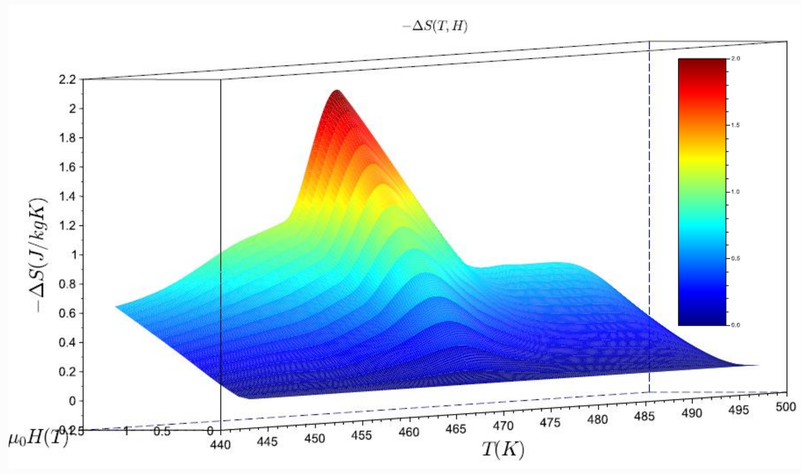
$T_C = 471\ K$



$T_C = 679\ K$

Compound	2/17	1/9	1/9C
T_C (K)	**439**	**471**	**679**





Conclusion & Perspectives

- $Sm(Fe,Ga)_9$ compounds have been successfully obtained by ball milling and subsequent annealing.
- Carburation of the samples improved the magnetic properties greatly, increasing T_C by 208 K and also reaching a coercivity H_C of 1.1 T (permanent magnet).
- Investigation of 1/9 hydruration and the resulting magnetic properties is underway.
- Samples still need to be annealed at various temperatures to optimize grain size, thus attaining higher H_C and increasing the magnet's specific energy.