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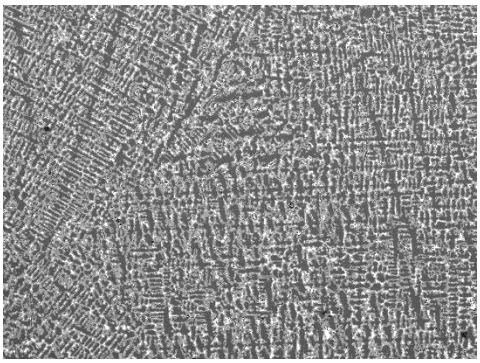
Investigation of phase stabilities of the boron doped RE(Fe,X)$_{12}$-type material systems

Promising magnetic properties can be obtained in materials crystallizing in tetragonal structure of ThMn$_{12}$-type ("1:12") [1,2]. Using rapid solidification (e.g. suction casting) technique, one can produce grains in submicron range which would help to modify the equilibrium phase diagrams. 1:12-type materials show comparable intrinsic properties to the widely used $Nd_2Fe_{14}B$ permanent magnet materials. However, for the 1:12-systems it is a challenge to stabilize the desired phases with proper microstructures [3].

In this work, the phase formation properties of the boron doped RE(Fe,X)$_{12}$-type materials will be investigated by tuning the synthesis methods and corresponding parameters as nominal compositions, heat treatment temperature and time. A systematic study will be carried out on selected compositions of the different REs and stabilization elements (X). After this work, the students will be able to synthesize materials from scratch and will gain hand on experience of the essential characterization techniques for material scientists.



Dendritic microstructure of a RE(Fe,X)$_{12}$ type material system.

Experience to be gained:

- Experience on industrially relevant preparation routes → induction/arc melting and suction casting
- powder x-ray diffraction (XRD)→ structural properties, phase identification
- Scanning Electron Microscopy (SEM) and energy dispersive x-ray (EDX) analysis→ Microstructure analysis and chemical composition determination.
- Vibrating Sample Magnetometer (VSM)→ magnetic property determination

[1] G.C. Hadjipanayis *et al.* Engineering 6 (2020) 141.
[2] S. Ener *et al.* Acta Materialia 214 (2021) 116968.
[3] H.I. Sözen *et al.*, Phys. Rev. Mat. 3 (2019) 084407.

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