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Operando muSR experiment on nano-crystal growing of the Fe-based magnetic material FINEMET(R) under external fields

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In recent years, there have been increasing opportunities to consider about energy issues on a global scale, and the development of energy-saving technologies in various fields is highly desired. It is known that Fe-Cu-Nb-Si-B nanocrystalline alloy, so-called FINEMET(R), have higher magnetic flux density, higher linearity, and higher temperature stability than conventional materials. Nano-crystals of FINEMET is grown by heat treatment of Fe-based amorphous alloys, showing different $B-H$ curves for various conditions of the magnetic field application during the heat treatment. However, the nanocrystallization process during heat treatment under magnetic fields has not been fully understood. To investigate elementary processes such as grain growth of nanocrystals, we have performed operando muon spin rotation experiments. It was reported that a remarkable time variation in crystal growing under several magnetic fields is seen [M. Ohta *et al.*, JPS Conf. Proc. **33**, 011053 (2021)]. Recently, more detailed analysis of time spectra with varying temperatures in the magnetic field has revealed the emergence of two distinct phases around the nanocrystal nucleation temperature. It is discussed how these two phases are related to nanocrystal nucleation and grain growth, also using the other technique such as transmission electron microscope (TEM) measurements and theoretical calculations.

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