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Neutron investigations of high coercivity hexaferrite

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The syntheses of aluminum substituted strontium hexaferrite nanoparticles, SrFe_{12-x}Al_xO<sub>
with x=0-3, via three different preparation methods were investigated: hydrothermal autoclave synthesis (AC), a citrate sol-gel synthesis (SG) and a solid-salt-matrix (SSM). Evaluation of macroscopic magnetic properties revealed that for the SG sample with x=3, the saturation magnetizationm was reduce by 68% to 22.6Am²/kg, while the coercivity was increased by 73% to 830kA/m (10.4kOe), when compared with the x=0 sample. This very high coercivity for hexaferrites is comparable with the coercivity seen in rare earth magnets.
Powder neutron diffraction (PND) patterns for all samples were collected at the powder diffraction instrument Echidna, ANSTO, Australia. Combined powder X-ray diffraction (PXRD) and PND Rietveld confirm that effective substitution of the Al only happens for the SG sample and reveal that the substitution occurs on the (2a)_{Oh} and (12k)_{Oh} sites at low substitution levels (x=1), as well as (4e)_{BP} and (4f)_{Oh} sites at higher substitution levels. The intrinsic magnetizations according to the refined moments and Al site occupancies from the NPD data are in remarkable agreement with the observed macroscopic magnetic data, confirming the robustness and accuracy of the model. The results reveal that Al only substituted into the structure in the SG sample. The Al site occupation fractions are also in excellent agreement with the previously reported theoretical calculations.

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