Pressure- and doping-induced magnetic phase evolution in $SmCrO_3$

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The magnetic interactions between rare-earth and transition metal moments are highly relevant for many researchers in the area of permanent magnets [1,2]. The interplay between 4f and 3d moments is particularly complex and gives rise to intriguing effects such as spin reorientation, exchange bias, multiferroicity, and spin switching [3]. The magnetic structure of $SmCrO_3$ has been intensively studied because of its potential multiferroic properties and complex magnetic phases [4] In rare-earth orthochromites, Mn substitution at the Cr site has shown versatile magnetic phenomena, and research on these materials has been revived in recent decades [5]. Many controversies over the microscopic spin configuration remain unsolved, presumably due to the complicated spin–orbit interactions, which are strongly coupled with each other and sensitive to structural and chemical modulation. In the present study, the $SmCrO_3$ crystal structure was characterized using powder X-ray diffraction followed by Rietveld refinement to determine its structural and microstructural properties. Magnetization measurements revealed the presence of two magnetic transitions: the Néel transition at 192 K and a spin reorientation transition at 34 K. These transitions were significantly shifted to lower temperatures, along with the evolution of a new phase at low temperature upon Mn doping.

In addition, the effect of hydrostatic pressure on the antiferromagnetic ordering of Cr spins and magnetic interactions in the Mn-doped $SmCrO_3$ compound was studied. Upon applying pressure up to 1 GPa, a slight increase in the Néel temperature and the spin reorientation temperature was observed. These results highlight Mn doping and pressure as effective control parameters for tuning magnetic interactions in correlated materials.

References:

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