

# Cation redistribution of piezoelectric ferromagnetic $\text{Ga}_{0.6}\text{Fe}_{1.4}\text{O}_3$ (010) films by Co-doping

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We have studied how Ga and Fe atoms distribute in the four different cation sites of GFO films by measuring X-ray absorption spectra and X-ray magnetic circular dichroism spectra and comparing them with theoretical models. The spectra were taken at Fe  $L_{3,2}$  and Co  $L_{3,2}$  edges of the  $\text{Ga}_{0.6}\text{Fe}_{1.4}\text{O}_3$  and 1.2 % Co-doped  $\text{Ga}_{0.6}\text{Fe}_{1.4}\text{O}_3$  films. The X-ray absorption spectra on Co  $L_{3,2}$  edges reveal that doped Co-ions favor  $O_h$  sites. The X-ray magnetic circular dichroism spectra on Fe  $L_{3,2}$  edges before and after Co-doping are different by far and they show that the  $T_d$  site occupation of Fe ions increases considerably after Co-doping, which implicates that the Co-doping leads to the overall redistribution of the cation atoms. The Fe occupation ratio of  $T_d$  and  $O_h$  sites are estimated by fitting the X-ray magnetic circular dichroism spectra with a cluster calculation. Finally the cation distribution of these films were obtained by implementing Gilleo's classical model which considers the presence of magnetically dead sites. We found that the cation atoms redistribute entirely after small amount of Co-doping and the total magnetization values of both films were well reproduced from the obtained distributions.