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Short-range atomic ordering in magnetostrictive Fe-Ga alloys
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— $Fe_{1-x}Ga_x$ alloys are known for having large magnetostriction (MS) while maintaining good ductility. Further improvement of the MS properties appears to be limited by Ga ordering. As Ga composition is increased, the MS coefficient is observed to peak, and then drop rapidly, when the system crosses over from a solid solution to an ordered alloy. X-ray diffuse scattering was used to study the Ga short-range order (SRO) as a function of composition and heat treatment. The data indicate the development of DO_3-type SRO with increasing Ga composition in the BCC solid solution. For the slow-cooled samples, the correlation length and area of the SRO scattering both increase dramatically beyond the peak in the MS at x = 0.18, indicating that the development of Ga clusters beyond a certain size limits the MS . The trends for the quenched samples are similar, but not as clear as the slow-cooled ones. The results indicate that nanoscale sized Ga clusters act to enhance the magnetoelastic coupling.

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