# $^{57}$Fe and $^{119}$Sn Mössbauer, XRD and ZFC/FC magnetization studies of arc melting $FeSn_2$ alloys

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Four $FeSn_2$ alloy samples were synthesized via arc-melting in an argon atmosphere, annealed at 450°C for 4 days, and quenched in cold water. Structural, magnetic, and hyperfine properties were systematically investigated using X-ray diffraction (XRD), ZFC/FCC magnetization (3–300 K), and $^{57}$Fe and $^{119}$Sn Mössbauer spectroscopies at room temperature. XRD analysis confirmed a predominant tetragonal $FeSn_2$ phase (space group I4/mcm) alongside a minor $\beta$-Sn ($I4_1/amd$), with one sample exhibiting an additional equiatomic FeSn phase. Temperature-dependent magnetization ($M-T$) revealed magnetic transitions at 50 K and 123 K, while ($M-H$) loops (3 and 300 K) indicated a superposition of ferro and antiferromagnetic signals. Room-temperature $^{57}$Fe Mössbauer spectra showed localized magnetism with a hyperfine field of $B_{hf} = 11.2\ T$, attributed to the ordering of Fe 3d magnetic moments. Meanwhile, $^{119}$Sn Mössbauer spectra revealed a transferred hyperfine field $B_{hf}^{tr} = 2.34\ T$ induced by neighboring Fe atoms, in good agreement with Medina et al. [1].