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# Epitaxial mosaic-like $Mn_5Ge_3$ thin films on Ge(001) substrates

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**Abstract**

Epitaxial mosaic-like $Mn_5Ge_3$ thin films were grown on Ge(001) substrates using reactive deposition epitaxy process from Mn deposition or Mn-Ge co-deposition at a substrate temperature of 250 °C using magnetron sputtering. The cross-sectional transmission electronic microscopy analyses reveal an abrupt interface at the atomic scale; two equivalent epitaxial relationships are found between the substrate and the $Mn_5Ge_3$ crystallites: Ge(001)[110] and $[1\bar{1}0] \parallel Mn_5Ge_3(1\bar{1}1)[\bar{1}\bar{1}0]$. The $c_{hex}$ axis of $Mn_5Ge_3$ forms an angle of 45° with the substrate plane. Rietveld analysis from a synchrotron 2-dimensional diffraction pattern revealed that remanent deformations of about 1% exist in the film. *M-H* measurements of 50-nm thick films elaborated by co-deposition revealed a saturation magnetization, $M_s$, of 636 $kAm^{-1}$, whereas the films elaborated by Mn deposition saturate at different values depending on the orientation of the applied magnetic field: $M_S^{\perp}$=545 $kAm^{-1}$ and $M_S^{\parallel}$=774 $kAm^{-1}$. This $M_s$ difference is attributed to shape anisotropy of crystallites and interface quality of the films.

Keywords: $Mn_5Ge_3$; Ge(001); epitaxy; sputtering; synchrotron; magnetic properties.