Growth of c-axis oriented barium ferrite film on (111) MgO underlayer
D. W. Erickson,1 Y. K. Hong,1 S. H. Gee,1 T. Tanaka,1 M. H. Park,1 and I. T. Nam2
1Magnetic and Electronic Materials Laboratory, Department of Materials Science and
   Engineering, University of Idaho, Moscow, Idaho 83844 USA
2Department of Advanced Materials Engineering, Kangwon National University,
   Chooncheon, Republic of Korea (South Korea)

Barium hexaferrite (BaM) film with perpendicular c-axis orientation was successfully
deposited on silicon substrates with an MgO (111) underlayer by rf sputtering and in-situ
heating at 920 °C. The magnetic and structural properties of 0.27 μm thick BaM films,
deposited on MgO (111) underlayers, were compared to films of the same thickness
deposited onto single-crystal MgO (111) and Al2O3 (000l) substrates by vibrating sample
magnetometry (VSM), x-ray diffraction (XRD), and atomic force microscopy (AFM). The
thickness dependence of MgO (111) underlayers was found to have a large effect on both
magnetic and structural properties of the BaM film. It was determined that 15 nm thick
MgO (111) underlayers produced BaM films with almost identical magnetic and structural
properties as the single-crystal substrates, this can explained by the lower surface roughness
for thinner underlayers. The magnetization saturation ($M_s$) and the ratio $H_{cβ}/H_{c⊥}$ for the
BaM film with a 15 nm MgO (111) is 217 emu/cc and 0.24, respectively. This is similar to
the results for the BaM films deposited on the single-crystal MgO (111) and Al2O3 (000l)
substrates of 197 emu/cc and 0.10, 200 emu/cc and 0.12, respectively. The proposed MgO
(111) underlayer, therefore, can be used in many applications to promote c-axis orientation
without the cost of expensive substrates.