Disorder in carbon-doped HPCVD MgB$_2$ thin films YE ZHU, P.M. VOYLES, Department of Materials Science and Engineering, University of Wisconsin, Madison, A.V. POGREBNYAKOV, X.X. XI, Department of Physics, Department of Materials Science and Engineering, and Materials Research Institute, Pennsylvania State University — Carbon-doped MgB$_2$ films prepared by hybrid physical-chemical vapor deposition have the highest $H_{c2}$ ($\sim$70 T at 0 K for H parallel to $ab$ plane) of all MgB$_2$ materials. We have characterized the nanoscale structure and chemistry of one such film by TEM and STEM. The C concentration in the Mg(B$_{1-x}$C$_x$)$_2$ grains from EELS is not dramatically higher than that of C-doped bulk MgB$_2$, so doping does not explain the high $H_{c2}$. Instead, the doped film has a variety of forms of structural disorder at length scales down to 5 nm, which may be sufficient to explain the high $H_{c2}$ of these films. These include MgB$_2$ domains with a 30 degree rotation about the $c$-axis, small angle rotations about $c$-axis, and a small tilt of the $c$-axis. There are also amorphous, C-rich regions between some MgB$_2$ domains. The amorphous phase comes from the oversupply of C during growth, which may also cause the other disorder by interrupting epitaxial film growth. This work is supported by the FRG on MgB$_2$, NSF DMR-0514592.

Ye Zhu

Date submitted: 16 Nov 2006

Electronic form version 1.4