NEWS | SEPTEMBER 17 2018

Bismuth defects create the largest magnetoresistance seen in an I-Mn-V semiconductor FREE

Mark Wolverton

Scilight 2018, 380004 (2018)
https://doi.org/10.1063/1.5058147

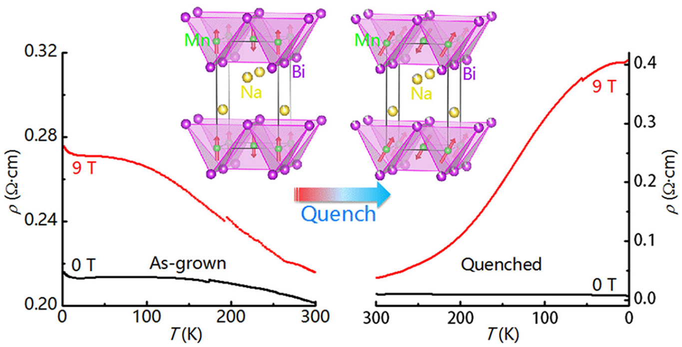
Scilight

20 September 2018

Bismuth defects create the largest magnetoresistance seen in an I-Mn-V semiconductor

Mark Wolverton

The only I-Mn-V semiconductor material to display such extreme magnetoresistance, NaMnBi may be suitable for practical room-temperature spintronics microelectronics.



One promising approach in the quest for room-temperature spintronics devices is the discovery and development of antiferromagnetic (AFM) semiconductors. New research from Yang et al. describes a new I-Mn-V AFM semiconductor, where I is either the element Li, Na or K, and V is As, Sb, or Bi, that displays extreme magnetoresistance of 600 percent at room temperature due to Bi defects in the crystal lattice.

The work examined as-grown and quenched single crystals of NaMnBi with X-ray spectroscopy, electron microscopy, and resistivity and magnetic susceptibility measurements. Both forms of this material can be easily synthesized in bulk, a distinct advantage over other common semiconductor materials.

In an applied magnetic field, the two crystal types are markedly different, with greater resistivity seen in the quenched crystal. With cooling, this leads to marked positive magnetoresistance, increasing by more than 10,000 percent between 2 and 9 tesla, and 600 percent at room temperature. This is the largest magnetoresistance yet reported in an I-Mn-V semiconductor and is seen in the samples with about 15 percent Bi vacancies in the structure.

The authors believe that these defects affect Mn orbital states, thus reorienting AFM moments, introducing charge carriers into the crystal lattice and changing it from semiconducting to metallic. Samples without Bi defects display greatly suppressed magnetoresistance, supporting the likelihood that hybridization of Mn and Bi orbitals is the chief cause of the large magnetoresistance.

The team believes that the extremely large magnetoresistance displayed by this AFM semiconductor material may make it well-suited as a magnetic electrode in room-temperature spintronics-based devices.

Source: “Defect-driven extreme magnetoresistance in an I-Mn-V semiconductor,” by Junjie Yang, Aaron Wegner, Craig M. Brown, and Despina Louca, *Applied Physics Letters* (2018). The article can be accessed at https://doi.org/10.1063/1.5040364.

Published by AIP Publishing (https://publishing.aip.org/authors/rights-and-permissions).