Antiferromagnet-based tunnel junctions

Cheng Song
Tsinghua University, China

Antiferromagnet (AFM) spintronics have emerged as a fascinating research area and stimulated intense interest due to their potential for ultrafast and ultrahigh-density spintronics. Magnetic tunnel junctions (MTJs) with only one ferromagnetic electrode exhibit tunneling anisotropic magnetoresistance (TAMR) dependent on the anisotropic density of states, but no room temperature performance so far. After the observation of TAMR at room temperature in antiferromagnet- based junctions, recently we provided an alternative approach to obtaining TAMR in α'-FeRh-based MTJs driven by the magnetic phase transition of α'-FeRh and resultantly large variation of the density of states in the vicinity of MgO tunneling barrier, referred to as phase transition tunneling anisotropic magnetoresistance (PT-TAMR). The MTJs with only one α'-FeRh magnetic electrode show a PT- TAMR ratio up to 20% at room temperature. Both the polarity and magnitude of the PT-TAMR can be modulated strongly by interfacial engineering at the α'-FeRh/MgO interface. Besides the magnetic field, some recent progresses on the modulation or switching of antiferromagnetic stacks by electrical means, electric field and current would be also briefly discussed in this talk. These findings might add a different dimension to magnetic random access memory and antiferromagnet spintronics.

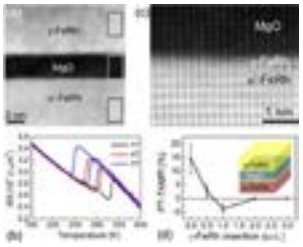

Figure 1: (a) Cross-sectional z-contrast STEM image of the stack films. (b) Resistance-area (RA) product of the α'-FeRh/MgO/γ-FeRh junctions as a function of temperature. (c) high resolution STEM Z-contrast image with one unit cell-thick γ -FeRh naturally superimposed at the α'-FeRh/MgO interface. (d) A summary of the PT-TAMR ratio as a function of the thickness of γ -FeRh insertion.

Biography

Cheng Song has completed his PhD at the age of 27 years from Tsinghua University and Postdoctoral studies from University of Regensburg. He was a Humboldt fellowship, and now is an associate professor in Tsinghua University, working on magnetic films and spintronic devices. He has published more than 120 papers in reputed journals with citation >3500 and has been serving as an editorial board member of Scientific Reports.

songcheng@tsinghua.edu.cn

Notes: