MAR09-2008-003385

Abstract for an Invited Paper
for the MAR09 Meeting of
the American Physical Society

Oliver E. Buckley Prize Talk: Spin polarized tunneling and tunnel magnetoresistance – Learning from the past and moving forward[1]

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Electron tunneling phenomenon has contributed enormously to our understanding of various branches of physics over the years. The technique of spin polarized tunneling (SPT), sensing the spin polarization of tunneling electrons using a superconducting spin detector, discovered by Meservey and Tedrow in the early seventies has been successfully utilized over the years to understand many aspects of magnetism and superconductivity. Electrical spin injection/detection in a semiconductor is strongly believed to succeed through such an approach. The successful observation of a large change in tunnel current in magnetic tunnel junctions (MTJ) in the mid nineties has brought extreme activity in this field – both from fundamental study as well as extensive application in mind (as sensors, nonvolatile memory devices, logic elements etc). From the early history of this field that led to the discovery of room temperature TMR effect to the observation of many novel phenomena to the exciting recent work on spin filtering, spin transport in semiconductors to toggling of the superconducting state with spin current will be highlighted and reviewed. Work done in collaboration with Drs. Meservey and Tedrow, PhD students, postdoctorals, as well as high school students and undergraduates. NSF, ONR, DARPA and KIST-MIT project funds supported the research over the years.

[1]NSF, ONR, DARPA and KIST-MIT project funds supported the research over the years.