Tunneling Magnetoresistance in Epitaxial Systems


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Abstract

Recent theoretical and experimental results have greatly increased our understanding of spin-dependent tunneling. New fundamental results include: (1) An understanding of how wave function symmetry can be used to achieve high TMR. (2) An understanding of how a high tunneling energy barrier can be consistent with (relatively) slow decay of the tunneling current with thickness. (3) A more complete understanding of the tunneling process. (4) A new paradigm for the growth of magnetic tunnel junctions.

Conclusions and Current Work

• For systems with two dimensional periodicity, wave function symmetry may be used to obtain high TMR through a spin-filter effect.
• FeCo-MgO-FeCo magnetic tunnel junctions illustrate this effect.
• TMR values as high as 600% at low temperature and 350% at room temperature have been achieved (S. Parkin – private communication)
• The parallel resistance is relatively independent of temperature and bias, consistent with the predictions of our theory.
• We are currently developing computer codes to calculate the tunneling current at finite bias using the non-equilibrium Green function approach of Keldysh (see posters #29 and #30).
• Devices based on this new type of coherent tunneling may include read sensors for hard drives and magnetic random access memory.

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