Coulomb Blockade Magnetoresistance in Magnetic Tunnel Junctions

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Abstract

Since the theoretical predictions and experimental observations of giant tunneling magneto- resistance (TMR) effect at room temperature in magnetic tunnel junctions (MTJs) with single-crystalline MgO(001) barrier[1–3], MgO barrier-based MTJs have been extensively studied due to their broad potential applications in spintronics devices. In this talk, we show that the Coulomb blockade voltage can be made to depend strongly on the electron spin in a discontinuous nano-magnetic granular layer inserted in the middle of an insulating layer of a tunnel junction. This strong spin dependence is predicted from the local intergranular magneto-resistance effects. The resulting Coulomb blockade magneto-resistance (CBMR) ratio can exceed the magneto-resistance ratio of the nano-magnetic granular layer itself by orders of magnitude[4]. Recent few experimental results have shown such novel CBMR effect. Unlike other magneto-resistance effects, the CBMR effect does not require magnetic electrodes. This feature shall open up broader applications for the CBMR effect.

Key Words: Coulomb Blockade Magnetoresistance, Magnetic Tunnel Junction

PACS numbers: 03.65.Yz, 85.75.-d, 72.25.-b, 73.40.Rw

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