Quantum Theory for Interfacial Roughness and Angle Dependence of Giant Magnetoresistance in Magnetic Multilayers

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Abstract: The giant magnetoresistance (GMR) in magnetic multilayers with current in the plane of the layers is studied by using the quantum-statistical Green's function approach, in which the effects of the interfacial roughness and magnetization configuration on the GMR are included. It is shown that the maximal GMR first increases and then decreases with increasing interfacial roughness, exhibiting a peak at an optimum value of interfacial roughness. An approximately linear dependence of GMR on $\sin^2(\theta/2)$ is obtained, where θ is the angle between magnetizations of the two successive ferromagnetic layers. Furthermore, the maximal GMR is found to increase with increasing the number of bilayers.

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