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Theory of Interlayer Magnetic Coupling in Nanostructures with Disordered Interfaces

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Multiple scattering theory of interlayer coupling in nanostructures with disordered alloy-like interfaces is developed. Interface-localized potential responsible for the specular electron reflection from a perfect interface (potential step) is found in the framework of multiple scattering theory based on Green's functions approach. This allowed obtaining of a general expression relating the interlayer coupling energy to electronic density of states change due to interferences of electronic waves resulting from multiple reflections at disordered interfaces. In the case of a small spacer electron confinement (small scattering), the interlayer exchange coupling between two ferromagnets separated by a nonmagnetic spacer is found in the coherent potential approximation for electrons scattering at the disordered interfaces. The influence of disorder on the oscillating with a metallic spacer thickness exchange coupling is analyzed. The main effect is found to be a phase shift and amplitude change of these oscillations with the change of the parameters describing specular and diffuse spin-dependent electron scattering caused by the interfacial disorder.

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