Electronic Superlattice Effects

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Artificial metallic superlattices are materials in which a periodic structure has been engineered by appropiate growth methods. These materials are predicted to exhibit unusual electronic properties due to this artificially added periodicity. Although many interesting phenomena have been discovered in artificial metallic superlattices[1], to date, no real superlattice effects have been found in the electronic properties. All effects are due at most to the presence of trilayers and the multilayer nature only provides a convenient way to study these single, bi and tri-layer effects.

I will describe recent work[2,3] in Co/Ni, Cu/Ni and Ag/Pd superlattices, in which the transport properties are found to oscillate with superlattice period[4-6]. This effect is critically dependent on the existance of a large number of layers, thus proving this to be a superlattice effect. Systematic studies show interesting behavior as a function of individual layer thicknesses, superlattice periodicity, number of layers, artificially added disorder, temperature and constituent elements. Based on these results, several possible theoretical models have been advanced; some relying on the changes in the density of states at the Fermi surface due to the superperiodicity, others based on enhanced scattering by localized d-electrons or quantum well states.

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