Magnetism, transport and optical properties of transition metal mono-silicides

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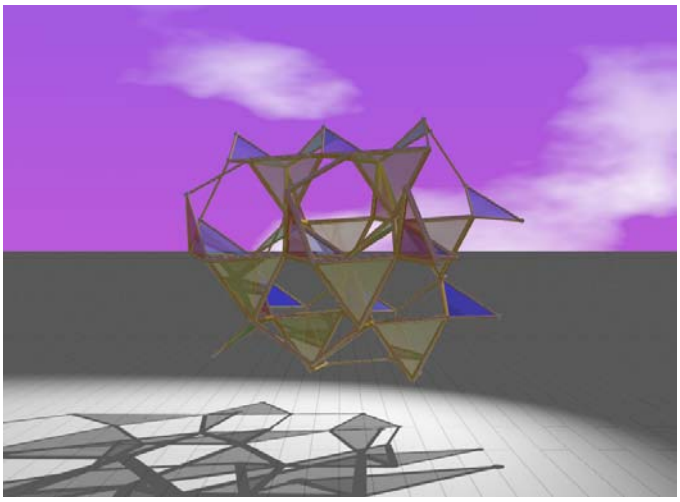

The strong paramagnetism of the narrow gap semiconductor FeSi and the helimagnetism of MnSi, both belonging to the class of B20 transition metial mono-silicides, are due to strong electroncorrelation effects of the 3d transition metal atom[1]. Partial Co substitution for Fe produces a spin-polarized doped semiconductor. The spin-polarization causes suppression of the metallic reflectivity and increased scattering of charge carriers[2], in contrast to what happens in other magnetic semiconductors where magnetic order reduces the scattering[3]. The loss of metallicity continues progressively even into the fully polarized state, and entails as much as a 25 percent reduction in average mean-free path. We attribute the observed effect to a deepening of the potential wells presented by the randomly distributed Co atoms to the majority spin carriers. This mechanism inverts the sequence of steps for dealing with disorder and interactions from that in the classic Al'tshuler Aronov approach[4] - where disorder amplifies the Coulomb interaction between carriers - in that here, the Coulomb interaction leads to spin polarization which in turn amplifies the disorder-induced scattering.

References

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