Helical spin structure in iron chains with hybridized boundaries

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Abstract

We have compared the magnetic properties of well-controlled ultra-short (<= 50nm) atomic iron (Fe) chains embedded in Fe-phthalocyanine films with those in Fe-hydrogen (H-2) phthalocyanine superlattices. Surprisingly, we found that the coercivity of the atomic chains with free boundary conditions is independent of the chain length, whereas the one subject to hybridization of the chain ends exhibits an unexpected length dependence. These findings suggest that ferromagnetism in the free-boundary condition system is caused by an intrinsic indirect exchange. On the other hand, controlled boundary conditions produce a helical spin structure due to an extrinsic indirect exchange, which arises from the interaction between iron atoms at the ends of the chain and the hydrogen in the H-2 phthalocyanine spacer. As a consequence, during magnetic reversal, ultra-short iron chains subject to boundary clamping develop a helical spin structure, leading to increased coercivity. These findings suggest unique insights and ideas for the design of atomic-scale ultra-dense magnetic storage nanodevices.

Palabras clave

KeyWords Plus:QUANTUM CRITICALITY; FERROMAGNETISM

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