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RESEARCH PAPER

Permanent magnetism in phosphine- and chlorine-capped gold: from clusters to nanoparticles

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Abstract Magnetometry results have shown that gold NPs (~2 nm in size) protected with phosphine and chlorine ligands exhibit permanent magnetism. When the NPs size decreases down to the subnanometric size range, e.g. undecagold atom clusters, the permanent magnetism disappears. The near edge structure of the X-ray absorption spectroscopy data points out that charge transfer between gold and the capping system occurs in both cases. These results strongly suggest that nearly metallic Au bonds are also required for the induction of a magnetic response. Electron paramagnetic resonance observations indicate that the contribution to magnetism from eventual iron impurities can be disregarded.

Keywords Gold clusters · Gold nanoparticles · EPR spectroscopy · SQUID magnetometry · Ferromagnetic behaviour

Introduction

Currently, many nanoscale applications such as electronic devices, systems with catalytic properties, magnetic and optical mechanisms, and biological systems (e.g. Andres et al. 1996; Valden et al. 1998; Sun et al. 2000; Boyen et al. 2002; Daniel and Astruc 2004; Tumer et al. 2008) include transition metal