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Permanent Magnetism, Magnetic Anisotropy, and Hysteresis of Thiol-Capped Gold Nanoparticles

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We report on the experimental observation of magnetic hysteresis up to room temperature in thiol-capped Au nanoparticles with 1.4 nm size. The coercive field ranges from 860 Oe at 5 K to 250 Oe at 300 K. It is estimated that the Au atoms exhibit a magnetic moment of $\mu = 0.036\mu_B$. However, Au nanoparticles with similar size but stabilized by means of a surfactant, i.e., weak interaction between protective molecules and Au surface atoms, are diamagnetic, as bulk Au samples are. The apparent ferromagnetism is consequently associated with $5d$ localized holes generated through Au-S bonds. These holes give rise to localized magnetic moments that are frozen in due to the combination of the high spin-orbit coupling (1.5 eV) of gold and the symmetry reduction associated with two types of bonding: Au-Au and Au-S.

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