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【173】Size Dependent Lattice Expansion in nanocrystalline BCC Tantalum: Unusual Superconductivity and Magnetism

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Particle size dependence of Tc and Hc in nanocrystalline (2-60 nm) BCC Tantalum was measured from electrical transport under magnetic field down to 50 mK. Both parameters show unexpected non-monotonic size dependence. Also, superconductivity is observed to persist for particle size even below the conventional estimate of Anderson limit. Again, when isolated Fe implants are embedded in Ta with particle size below 8 nm, a stable magnetic moment is observed (using the time differential perturbed angular distribution technique), whereas none is observed for larger particle sizes or BCT-Ta (β-Ta) films. The observations are explained using ab initio calculations indicating both effects are related to the strong size-dependent lattice expansion (˜4%) in Ta, which influences the electronic and phonon band structure.

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