Probing magnetic anisotropy and exchange bias in coupled Au-Fe$_3$O$_4$ nanoclusters

S. CHANDRA, N.A. FREY, M.H. PHAN, H. SRIKANTH, University of South Florida, C. WANG, S. SUN, Brown University — The study of magnetic anisotropy and exchange bias in coupled nanoparticle systems is of topical interest. We have demonstrated radio frequency (RF) transverse susceptibility (TS) using a sensitive, self-resonant tunnel-diode oscillator (TDO) technique developed by us to be excellent for probing magnetic anisotropy and exchange bias (EB) in Fe$_3$O$_4$ particles grown epitaxially on one or multiple facets of polyhedral Au seed particles forming dumbbell- or flower-shaped Au-Fe$_3$O$_4$ nanoclusters. TS experiments reveal a strong increase in magnetic anisotropy in coupled Au-Fe$_3$O$_4$ nanoclusters compared to pure Fe$_3$O$_4$ nanoparticles. TS experiments also probe a surface spin glass transition ($T_F$), a sharp increase in surface anisotropy at $T_F$, and a strong increase in EB with temperature below $T_F$ in the flower-shaped nanoclusters. Our RF susceptibility measurements are in good agreement with conventional AC and DC magnetometry. The influence of the Au interface(s) on the surface spin configuration of Fe$_3$O$_4$ nanoparticles will be discussed.