Low Temperature Analysis of Nickel Nano Particles by SQUID Based AC Susceptibility

J. R. O'Brien[a], A. Strydom[b], and W. G. Coors[c]

[a]Quantum Design, San Diego, CA, 92121
[b]Department of Physics, University of Johannesburg, South Africa
[c]Ceramatech, Salt Lake City, UT 84119

The solid oxide fuel cell material 10 percent yttria stabilized zirconia (10YSZ) plus addition of 1 mass percent NiO serves as a model system. With electronic field assisted reduction (e-FAR)technique, the dissolved Ni2+ ions transform into super-paramagnetic Ni metal particles. The temperature dependence of the AC susceptibility response confirms reasonably narrow size distribution on the bulk scale. The unique capability of SQUID based AC to run at low 1 Hz frequence broadens transition towards lower temperatures. The onset for out-of-phase component scales with particle size and the 3.5 K blocking temperature suggests 2-3 nm range. Extending the analysis to 0.5 K with helium-3 insert enables further characterization of these smallest Ni nano particles. Finally, the size dependent function for small DC biased fields to suppress AC response is presented.