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Nanoparticle-Organic Composite Electronic Materials for Chemical Sensors STEPHEN HOWELL, SHAWN DIRK, DAVID WHEELER, Sandia National Laboratories — Molecular electronic based chemical vapor sensors were assembled using noble metal nanoparticles and short conjugated phenylene ethynylene (PE) based molecules. Sacrificial capping ligands on the nanoparticles were replaced by tighter binding PE ligands. The films were assembled between pairs of electrodes by iteratively exposing the substrates to solutions of the nanoparticles and PE crosslinking bridging ligands. Some of the conjugated bridging molecules contained an electron deficient phenol to provide a simple platform for developing sensor applications. The phenol is calculated to have a significant change in its HOMO/LUMO gap in the presence of specific analytes. Judicious combination of nanoparticle size and ligand structure provides a film in which the organic bridging ligands dramatically affect film conductance. Specifically, π-conjugated ligands lower resistance more in films with smaller particles. Thus the sensing mechanism of these films is not based on the typical swelling mechanism but rather on the modulation of the molecular electronic structure of the conducting PE bridging ligands.

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