**Title: Characterization of Model Chemical Mechanical Planarization Slurry Nanoparticles Using Enhanced Darkfield Microscopy with Hyperspectral Imaging.**

**Abstract:**

Although engineered nanomaterials (ENMs) are increasingly incorporated into commercial products, the environmental and human health and safety effects associated with ENMs are unknown. At present, there is no universal standard for environmental ENM characterization and there is a need for novel tools that can rapidly and economically characterize environmental ENM samples. The semiconductor industry uses ENMs in a process called chemical mechanical planarization (CMP) and research indicates that modern wastewater treatment systems do not prevent 100% of CMP ENMs from reaching environmental waters. In this study, enhanced darkfield microscopy combined with hyperspectral imaging (EDFM-HSI) was used to characterize three model CMP slurries containing $SiO_2$, $CeO_2$, or $Al_2O_3$ nanoparticles (NPs). EDFM-HSI data were used to: differentiate, identify limit of detection (LOD), and generate calibration plots to estimate concentration for all three ENMs. The EDFM-HSI LOD was defined as the NP concentration where SAM pixel mapping resulted in less than 95% certainty. The LODs of $SiO_2$, $CeO_2$, and $Al_2O_3$ were 0.003, 0.0001, and 0.00003 wt% respectively. It is possible to differentiate the three ENMs because $CeO_2$ spectra have higher intensity light scattering signal then $Al_2O_3$ and $SiO_2$. In addition, $SiO_2$ spectra have a shape distinct from $Al_2O_3$. Calibration plots were created using HSI data and will be used to estimate concentrations. The results show that EDFM-HSI differentiated CMP NPs, identified LODs, and created calibration plots that may accurately estimate NP concentrations. Therefore, EDFM-HSI has potential as an environmental ENM characterization tool.