# CALIFORNIA STATE SCIENCE FAIR
# 2014 PROJECT SUMMARY

**Name(s)**

**Charley Huang; Jed McGuigan**

**Project Number**

**S0609**

**Project Title**

## Gold and Palladium Nanoparticles as Catalysts for Nitrite Reduction in Drinking Water and Local Water Sources

**Abstract**

**Objectives/Goals**

Nitrite contamination, which can cause birth defects, is a growing dilemma facing the global population today, especially in agricultural communities due to the increased use of nitrate rich fertilizers which can contaminate local water supplies. We tested Gold, Palladium, and Pd-on-Au Nanoparticles' effectiveness as catalysts for nitrite reduction. We also detected of the concentration of nitrites in drinking water or sources of drinking water via High Performance Liquid Chromatography.

**Methods/Materials**

Gold, Palladium, and Palladium on Gold Nanoparticles were synthesized from Chloroauric(III) Acid, Tannic Acid, Potassium Carbonate, Trisodium Citrate, Palladium(II) Chloride and Hydrochloric Acid. Hydrogen and Carbon Dioxide gas were bubbled into each nanoparticle catalyst and sodium nitrite solution to induce a reduction reaction. Reduction efficiency as well as water sample nitrite concentrations were analyzed via HPLC (Column: Agilent AN1 Anion Exchange Column; Sample Size: 20 uL; Flow Rate: 1mL/sec; Detection: UV, 210; Solvent: 1.7 mM $NaHCO_3$ Solution; Temperature: 35 degrees C; Run Time: 20 minutes, 2 minute cooldown)

**Results**

We determined that 30% sc Pd-on-Au NPs were the most effective in the reduction of nitrite to nitrogen gas, decreasing nitrite concentrations to 88% of its original value ($p<0.05$). 100% sc Pd-on-Au NPs and pure Au NPs decreased nitrite concentration by 11% and 16% respectively ($p<0.05$). However, both 300% sc Pd-on-Au and pure Pd NPs failed to produce any significant results. In detecting nitrite concentrations in common water sources, only tap water produced trace amounts of nitrite contamination (0.04356 ppm).

**Conclusions/Discussion**

The most effective nanoparticle catalyst was the 30% surface coverage Pd-on-Au nanoparticle, with a bell shaped curve for effectiveness around the 30% sc nanoparticle. Furthermore, HPLC detection proved that no nitrite ions were present in detectable concentrations in bottled water and local area water. However, trace amounts of nitrites were detected in tap water, although much lower than the WHO standard of 0.91 mg/L.

**Summary Statement**

Tested Pd, Au, and Pd-on-Au Nanoparticles of various surface coverages to catalyze nitrite reduction as well as used HPLC to determine nitrite concentrations in different water sources.

**Help Received**

Dr. Malhotra allowed use of TOHS lab and HPLC machines; Dr. Cauchon mentored us in HPLC techniques; Dr. Tannaci donated chemicals and supplies; Dr. Quinlan supervised work in CLU Laboratory; Karen Kearsley donated HPLC Column