



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Kaidi He	Project Number S0508
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Project Title Synthesis of Palladium Nanowires by Electrodeposition onto Highly Oriented Pyrolytic Graphite
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Objectives/Goals The project was aimed at finding the best combination of nucleation time, deposition time, and deposition potential for palladium nanowires. It was hypothesized, from the third scan of a cyclic voltammogram taken, that the deposition potential would be approximately .400 V. It was hypothesized that the nucleation time would be anywhere ranging from 5-7ms, and the deposition time anywhere from 600s-1800s based on previous research.	Abstract
Methods/Materials Materials: Highly Oriented Pyrolytic Graphite (HOPG) Palladium Nitrate Solution: 60% HClO ₄ (1.54 g/mL, 9.2 M), Water, Pd(NO ₃) ₂ #H ₂ O Potentiostat, Saturated Calomel Reference Electrode, Palladium Flag, Working Electrode, SEM, Scotch tape, ECHEM Software, Light microscope Methods: A solution of Pd(NO ₃) ₂ H ₂ O was made. The working electrode containing HOPG, counter electrode, and reference electrode were inserted into the solution. During the conditioning period, the graphite was oxidized using the ECHEM program. A nucleation pulse was then applied to initiate the nanowire growth. Following their deposition, the wires were taken to the Scanning Electron Microscope (SEM) and imaged.	
Results After repeated trials, the best conditions for optimal nanowire growth was determined to be a deposition potential of .370 V, deposition time of 1200s, and nucleation time of 5ms. The hypothesis that the deposition potential would be near the value of 400 V was confirmed to be correct.	
Conclusions/Discussion Palladium nanowires of diameters ranging from 62.9 to 159 nm were synthesized by electrodeposition onto highly oriented pyrolytic graphite. Variables of nucleation times, nucleation potentials, and deposition potentials were adjusted to produce the most structured nanowires. It was concluded that a deposition potential of .370 V, a deposition time of 1200s, and a nucleation time of 6 ms resulted in optimal wire growth.	

Summary Statement This project attempts to find the optimal combination of variables of nucleation time, deposition time, and deposition potential for producing the most structured nanowires by the electrodeposition of palladium onto HOPG.

Help Received I worked in the lab of Dr. Reginald Penner at University of California of Irvine, under the supervision of Dr. Penner and Stacey Rogers.
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