Environmental Catalysis: Synthesis and Performance of CU-ZSM-5 Catalysts for Reduction of Noxious Emissions from Automotive Deisel Engines

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As students, staff, teachers or administrators at Hopi Jr./Sr. High School; all of us need new challenges and new educational experiences in our lives. Many of our students tune out the material they are supposed to learn because they think: 'when will I ever use this again?' This past summer I was invited to participate in the CISTAR program for teachers at Purdue University in West Lafayette, Indiana. This program accepted only 7 teachers into the Chemical Engineering Department at one of our nation's most competitive Engineering universities. I was 1 of only 2 educators from the western United States.

The intent of the CISTAR program is to provide research experiences and a teaching unit for STEM teachers at the secondary level that teachers will apply in their teaching situation. My project studied how to remove noxious gasses from diesel engines to clean up the air and make the big trucks on the interstates run more efficiently. We simulated a diesel engine in the Chemical Engineering labs at Purdue using gasses in the same ratio as a diesel engine would use them. We tested our own Copper Hydroxide catalyst that was similar in every way to a commercially available Copper hydroxide catalyst that was supposed to make noxious chemicals stick to it and hence not get released into the air.

Another part of our study was to improve efficiency of the diesel motor at under 200 degrees Celsius. This is essential because big rig diesel engines take about 20 minutes to warm up and that is when they are belching out the greatest amount black smoke. After the engine warms up, there is a lot less pollution sent into the environment. This is the holy grail of Chemical Engineering and the person who figures this problem out will become a very wealthy person. If this sounds interesting to you or somebody you know; please contact the Principal Investigator at fabio@purdue.edu. It might just be a life changing experience.

If engineering isn't for you…National Endowment for the Humanities (www.neh.gov) and the Gilder Lehrman Institute lists will be posted in late October. These are more suited for the Humanities and teachers can learn about more interesting topics of study. If anybody would like to be recommended for the St. Johns College Tecolote seminar series next year or just want to admire my poster in Chemical Engineering; please stop by my office.

Keywords: Chemical Engineering, Environmental Engineering

Study of High Tc Superconductivity in Silver Materials

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There have been recent reports of the experimental observation of room-temperature superconductivity in silver nanostructures from some researchers in India. The phenomenon of superconductivity was discovered more than 100 years ago, with breakthroughs in the 1960s bringing it into practical application in a variety of technologies. The critical temperature, or Tc, for superconductors discovered to date lies between 0 and 136 Kelvin (-460 and -214 degrees Fahrenheit). Thus, most current superconductors require expensive cooling equipment. Scientists are searching for new materials that are superconductors at higher temperatures, and which can be mass produced. We present the results of a theoretical, first-principles study of silver-based materials. We have determined the electronic structure, phonon dispersion relations, Eliashberg spectral function, electron-phonon coupling constant (λ) and any other signs of superconductivity, for large (Agn) silver clusters and (AgnXm) silver-based clusters, varying in size from 8 atoms to 100 atoms. We found that some of our structures are characterized by a much larger electronic density of states at the Fermi level. We used both norm-conserving pseudopotentials and ultra-soft pseudopotentials in studying the relevant properties. One novelty of our work is that it goes beyond the electron pairing mechanism. The transition temperatures (Tc) for superconductivity in two of our clusters are 180 K and 200 K, while the electron–phonon coupling constants are 0.52 and 0.71. The superconductivity disappears for pressure near 2.0 MPa. One interesting application of such work is in power lines made of superconducting materials, to reduce the energy lost in transmission. Superconducting magnets are used in high-speed levitating trains and in wind turbines.

Keywords: Superconductivity, Silver, Computational, High-Temperature