



Mark Justin Parfan Llorente

Graduate Institution: University of California-San Diego

Graduate Discipline: Materials Science and Engineering

Hometown: San Francisco, CA

Relevant SC Research: Basic Energy Sciences

Research Interest:

Photocatalytic CO_2 chemistry has been a primary interest of mine since before I joined graduate school. Solar energy is the most plentiful source of ambient power on the earth. Whether or not we will rely on alternative energies is not a question of if but when. Hydrocarbon fuel sources are becoming scarce with ever increasing difficulty to recover new sources of oil. In order to mitigate the damage of human activity stimulated by fossil fuel consumption, a separate carbon cycle may be implemented wherein solar energy will be utilized to reduce CO_2 to useful products. I am investigating the potential for more efficient consumption of hydrocarbon fuels by photocatalytic processes. In principle, a fuel cell is limited not by the Carnot cycle but by the overpotentials required to oxidize the hydrocarbons. Using photocatalysts may allow us to overcome kinetic barriers, facilitating easier access to the energy in fuels. Metal oxides like TiO_2 and SrTiO_3 are our photocatalysts of choice because of their robustness and high faradaic efficiencies for the oxidation of various organic substrates.

About Me:

I am studying materials and inorganic chemistry under Professor Clifford Kubiak. As the senior engineering student in a predominantly inorganic and physical chemistry lab, my work extends beyond photoanode development into creating and maintaining laboratory equipment

and networks. In the past I have worked as a private physics, mathematics, and chemistry tutor for a small local company and continue to assist other lab members in teaching their undergraduate students.

My intended career direction follows two possible paths both relevant to science education. One of my greatest joys is to teach and develop the understanding of difficult ideas. A serious challenge in educating students is to cultivate a desire to confront and interact with these ideas. There are two student age ranges that would direct my career path, the developmental years from 11 to 17 years of age, and the maturing years from 18 to 25. If I were to work in education the of students in their earlier years, I would prefer to work in research and policy with companies like SRI that focus on developing programs and technology that target fundamental understanding and the utilization of ideas, moving away from the current model of rote memorization and standardized methods. Middle school and high school are dramatic periods of sudden mental development followed by a solidification of thinking habits. Building good independent thinking habits early and preventing unhealthy ones should be a key focus during this period, and thinking like a scientist does not come naturally, especially in the face of our current education models. If I were to work with college and graduate age students, I would most like to work as a lecturer at an R2 institution, using some time to teach, some time to develop

courses, and the rest to do research in solar energy conversion and energy storage.

It is one of the greatest disservices to the next generation to teach them that success is limited to following a prescription and arbitrary standards. The American economy has been largely driven by technical innovation and inventions, and replenishing the work force with fresh and capable minds in technical fields is of utmost importance to us all. If we can start good habits and develop curiosity early, getting students to think with both depth and flexibility, we set a strong foundation for our country's future, one student at a time. I recognize that I would never have made it as far as I already have without teachers and an education that asked me to always question and to always explore those questions. It has taken many mentors for me to get where I am, and intend to pay it forward. I firmly believe that more people with scientific training need to pass on this wisdom and their knowledge to the next generation, and few are as well equipped to do so. A scientist who can teach seems like a natural person to teach science.

Outside of graduate studies, I am practicing Jeet Kune Do, a martial art and philosophy famously developed by Bruce Lee. I dance socially in both swing and blues dancing venues. I am restarting my practice of Olympic style recurve archery, which I practiced competitively in UC Berkeley.



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