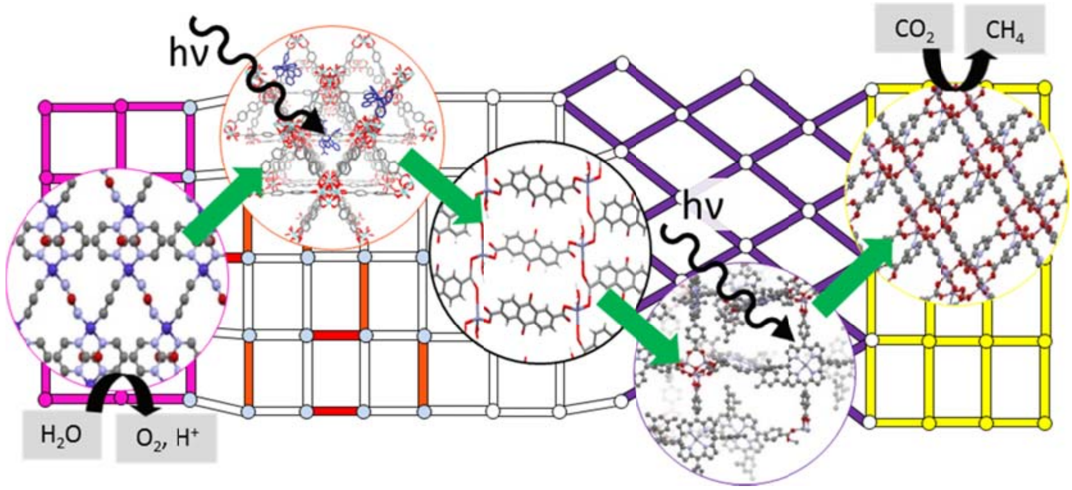
JMU Chemistry and Biochemistry Seminar
Friday, February 6, 2015
3:35pm in ISAT 159

A Fundamental Perspective on Next Generation Solar Energy Solutions



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The finite supply of fossil fuels and the possible environmental impact of such energy sources has garnered the scientific community's attention for the development of alternative, overall carbon-neutral fuel sources. The sun provides enough energy every hour and a half to power human civilization for an entire year. However, two of the remaining challenges that limit the utilization of solar energy are the development of cheap and efficient solar harvesting materials and advances in energy storage technology to overcome the intermittent nature of the sun. In the seminar, the research projects to be discussed focus on two aspects of solar energy conversion: Solar Energy Storage through Artificial Photosynthesis and Cheap, Efficient Solar Cell Architectures.

Natural photosynthetic systems utilize the sun's energy to transform CO_2 and H_2O into carbohydrates, nature's stored solar fuel. Artificial photosynthetic systems that can oxidize H_2O and reduce CO_2 efficiently to a fuel could represent the breakthrough solar power needs to become a viable energy source. Photocatalysis of this kind is most efficient if the rate of catalytic activity is greater than or equal to the solar flux (the rate at which photons hit the earth's surface). To date, there exist no catalysts that have both the high active surface area and solar absorptivity necessary to meet this requirement. Metal organic frameworks (MOFs), porous 3-D networks of inorganic nodes and bidentate organic struts, are the highest surface area material known and hold the potential to reach unmatched catalytic rates per geometric area. The application of MOFs as integrated artificial photosynthetic arrays will be discussed.

In addition to the development of new photocatalytic assemblies, more efficient and economical direct solar-to-electric cells are needed. The 2010 total cost of a residential PV system was $6.60/W, more than 4 times the Department of Energy goal of $1.50/W by 2020. The dramatic and quick cost reduction required to reach this goal necessitates the development and demonstration of revolutionary next generation PV technology. In the next generation PV arena, the Morris Group studies two solar cell architectures: (1) Hyrbid Bulk Heterojunction Solar Cells (HBHJs), and (2) Quantum Dot Sensitized Solar Cells.