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Artificial Photosystem I and II: Highly Selective solar fuels and tandem photocatalysis YUCHEN DING, IGNACIO CASTELLANOS, LOGAN CERKOVNIK, PRASHANT NAGPAL, University of Colorado — Artificial photosynthesis, or generation of solar fuels from CO_2/H_2O, can provide an important alternative for rising CO_2 emission and renewable energy generation. In our recent work, composite photocatalysts (CPCs) made from widebandgap nanotubes and different QDs were used to mimic Photosystem II (PS680) and I (PS700), respectively. By tuning the redox potentials using the size, composition and energy band alignment of QDs, we demonstrate highly selective (>90%) and efficient production of ethane, ethanol and acetaldehyde as solar fuels with different wavelengths of light. We also show that this selectivity is a result of precise energy band alignments (using cationic/anionic doping of nanotubes, QD size etc.), confirmed using measurements of electronic density of states, and alignment of higher redox potentials with hot-carriers can also lead to hot-carrier photocatalysis. This wavelength-selective CPCs can have important implications for inexpensive production of solar fuels including alkanes, alcohols, aldehydes and hydrogen, and making tandem structures (red, green, blue) with three CPCs, allowing almost full visible spectrum ($410 \sim 730$nm) utilization with different fuels produced simultaneously.

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