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Sandia National Laboratories

Solar Thermochemical Fuels

A drop-in alternative to petroleum

Problem Statement:

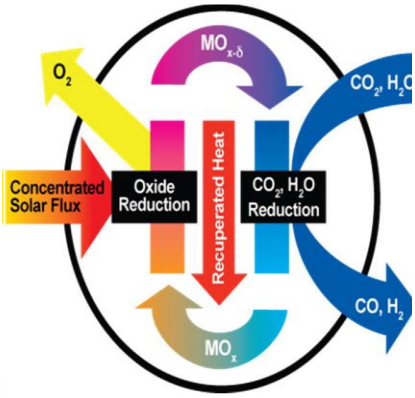
An additional 64 mb/d of petroleum – six times the current capacity of Saudi Arabia – will be needed in the U.S. by 2030. Currently, biofuels alone are expected to meet the additional demand and begin to replace petroleum, but biofuels have limited capacity and many technical hurdles. Solar fuels are a largely unexplored option; yet, the technology is straight-forward conceptually. Systems-analysis shows a clear path forward to scale-up and deployment.

Approach:

Sandia's solar thermochemical process to convert "Sunshine to Petrol" (S2P) uses the heat of concentrated solar power to split oxygen from CO_2 and H_2O in order to produce syngas, a known precursor to drop-in hydrocarbon fuels. CO_2 and H_2O splitting is performed in a two-step redox reaction using redox-active metal oxides. R&D focuses on reactor and materials development. The reactor must separate reaction and product gases, continuously use incident solar energy to heat the metal oxides, and perform heat management (transfer) to increase efficiencies. The materials must shuttle oxygen with high thermodynamic and kinetic efficiency and remain stable at temperatures approaching 1600°C. To date, Sandia has built two reactor prototypes, tested multiple metal oxide formulations, and successfully split CO_2. We hold the current world record for solar to chemical storage efficiencies, and recent Sandia-patented perovskite materials promise to set new standards.

Impact:

Solar fuels are drop-in, scalable, and, with adequate investment, viable within 10 years. They are a necessary option in a limited set of possible solutions to meet growing demand and to transition from finite, unclean, and politically unstable petroleum.



Using only CO_2 and H_2O and less than 0.1% of land west of the Mississippi, solar fuels can entirely replace current U.S. petroleum consumption while mitigating greenhouse gas emissions.

Anthony Martino
martino@sandia.gov

U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

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