Renewable Energy Storage by CO₂ Recycling

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We have significantly greater renewable energy resources than can effectively be utilized by the electric grid due to intermittency and remoteness of the resources from large load centers. A further barrier to greater exploitation of renewable energy is that in some locales it may be competing with very low cost generation resources. For example, in many regions off-peak nuclear power is available at very low cost. Of much more urgent concern than electricity generation is the cost and assured availability of transportation fuels. Developing a means of storing intermittent renewable energy and off-peak nuclear energy as liquid transportation fuels offers improved economic prospects and a solution to the energy security of our transportation fuels while simultaneously reducing net CO₂ emissions.

Many countries are now considering taxing CO₂ emissions, which will increase the cost of products that are associated with those emissions. The most common method currently considered for dealing with CO₂ emissions is the capture of the gas, pressurization, and then sequestration in either rock formations or saline aquifers. This is relatively costly in both capital investment and operation of the equipment. Also, there is the possibility that this CO₂ will escape at some point in the future subjecting the CO₂ generators to a perpetual and unquantifiable liability.

Ceramatec has been investigating an alternative approach that converts CO₂ into valuable transportation fuel. Using the solid oxide fuel cell materials set in conjunction with a non-carbon electric energy sources it is possible to generate synthesis gas (CO and H2) and oxygen from CO₂ and H_2O. This high temperature co-electrolysis (HTCE) process can use both thermal and electric energy inputs to electrolyze the CO₂ and H_2O at 100% thermodynamic efficiency. This is possible because the high temperature co-electrolysis reactions are endothermic, and the heat generated by resistance in the electrochemical device is chemically recuperated in the process. We have demonstrated conversion of this CO₂ derived syngas to liquid fuels via the Fischer Tropsch process.

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