Science & Technology

Energy-dense processing

by Marsha Freeman

Last week, EIR, *presented in this column an overview of how commercially developed thermonuclear fusion power will transform and vastly expand the globe's accessible base of so-called "raw materials." Here our Science and Technology editor outlines the way that energy-dense levels of chemical processing can make synthetic fuels and other specific energy potentials—now slated to drain funding, capital goods, and energy efficiency for lack of an adequate primary energy process—into an economic proposition.*

Important developments are already underway in the use of the electromagnetic and particle energy from current energy-consuming plasmas and future energy-producing plasmas. While it is doubtful that large-scale materials reduction employing fusion plasma can proceed before fusion reactors are deployed on a broad commercial scale, here is a field in which rapid R&D progress can be made now.

Ultraviolet (UV) radiation is now used commercially for sterilization and photolysis. By injecting trace amounts of impurities, potentially aluminum, into selected materials, the radiation field of the fusion plasma in a torch could be tuned to produce high levels of UV radiation. The UV can be transmitted from the plasma through a window and absorbed by the working fluid.

UV radiation is used commercially at the present time for sterilization of high-cost foodstuffs like milk. If produced more cheaply through fusion, it could be applied to desalination of water, processing of urban sewage, conversion to electricity through fuel cells, and for many kinds of plasma chemistry.

UV photons could be used for photodisassociation of water into hydrogen and oxygen. It has been estimated that hydrogen production through the use of a water vapor cell utilizing UV radiation could be produced at comparable prices with proposed nuclear-based processes, and at less than current costs of electrolysis. This process would mirror the continual UV disassociation of water that takes place in the upper atmosphere through rays of sunlight.

As the mid-1970s made the energy crisis the major focus of concern to policymakers, fusion scientists focused their attention on the production of synthetic fuels from fusion energy. A series of reports and a workshop sponsored by the Electric Power Research Institute (EPRI) beginning in 1976 brought together the teams of scientists and engineers in the fusion and related fields to evaluate future research paths for non-electric uses of fusion power.

Fusion transforms fuel potential

Many concepts, nearly all of which should be investigated experimentally, have come to the fore to produce conventional, carbon-based liquid and gaseous fuels using fusion power, as well as the fuel of the future—hydrogen. The irony is evident: a commitment to the most efficient overall energy mode transforms not only the resource question but the economics of producing specific fuels.

Nearly every excitive radiation produced in fusion can be used for the production of synthetic fuels. These include microwaves for plasma chemistry to mix carbon dioxide and hydrogen to produce methane; the use of UV and soft x-rays for photochemistry to disassociate water to produce hydrogen; the use of the 14MeV neutrons for radiolysis, similar to x-ray processes; and the use of the charged particles in a torch to disassociate water or recombine carbon fuels.

The private KMS Fusion company has proposed using laser fusion systems for the production of hydrogen through radiolysis. A team of researchers at Brookhaven National Laboratories has designed an entire synfuel production flow train using water, coal and carbon dioxide as the raw materials. Fusion, rather than burning vast amounts of coal, could provide up to 40 percent of the energy required for gasification or liquefaction techniques. And as coal became more expensive, or was not available in certain areas, it could be substituted for by extracting carbon dioxide from the air or the oceans.

A combination of the heat and electricity produced from fusion has been suggested in high-temperature electrolysis designs as a way to produce hydrogen from water. So have thermochemical cycles.

In their concluding statement in their 1969 report to the Atomic Energy Commission on fusion applications, Bernard C. Gough and Bernard J. Eastlund remark that "the vision is there, its attainment does not appear to be blocked by nature. Its achievement will depend on the will and the desire of men to see it brought about."