—ABSTRACT—

Hydrogen Futures, Nuclear Energy, and Separations

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The world is entering the hydrogen (H_2) age. The present worldwide demand for H_2 is ~50 million tons per year and growing rapidly. Current projections indicate that conventional oil production will peak in this decade and then decrease. The shortfalls in production are likely to be offset by conversion of tar sands and other low-grade hydrocarbon deposits to liquid fuels in Canada, California, and Venezuela. This process requires massive amounts of H_2 because the H_2-to-carbon ratio of these lower-grade oil supplies must be increased to produce usable liquid fuels. Over the next 10 years, the announced investments in the Canadian tar sands alone exceed $37 billion. These developments and the long-term issues of global climatic change are likely to lead to a H_2 economy, in which H_2 (or one of its carriers such as ammonia), is the replacement fuel for transport vehicles.

Nuclear energy using thermochemical cycles is potentially an attractive method for H_2 production because it generates no greenhouse gases and matches the required scale of production. Thermochemical cycles convert high-temperature heat from the nuclear reactor plus water to H_2 and oxygen through a series of chemical reactions in which all other chemicals are recycled. Because of the scale of H_2 production, within a few decades the most important and largest throughput separation processes in the world may be associated with these H_2 production processes. For the separation sciences, this presents new challenges that must be met to address the world's energy issues.