258e Applicability of Inorganic Membranes for the Production of Hydrogen Using Nuclear Energy

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The efficient separation of gases at high temperatures can improve the efficiency of two of the leading processes for producing hydrogen using the heat from a nuclear reactor, thermochemical water splitting and high temperature electrolysis. The Sulfur-Iodine (SI) thermochemical process thermocatalytically cracks water yielding hydrogen and oxygen. The SI process consists of a series of chemical reactions where all the chemicals are recycled in the process except for water. The SI process is efficient, scalable to large sizes, and uses no expensive chemical reagents; however, it has one major disadvantage. The thermal decomposition of sulfuric acid requires high temperatures (800 to 900 °C). However, there is a potential to lower the peak temperature by 200+ °C if the decomposition products of sulfuric acid, O_2, H_2O, and SO_2, can be separated from SO_3 using an inorganic membrane. First generation membranes have been fabricated and we will present preliminary separation data showing the potential to separate the product gases from SO_3. We will also present results of the stability of these membranes under simulated operational conditions. High temperature electrolysis uses a solid oxide electrolyzer to split water into hydrogen and oxygen. The oxygen is removed by the electrolyzer with the remaining gas being a mixture of product hydrogen and the residual steam. The efficiency of this process can be improved if a large fraction of the hydrogen can be removed at the operating temperature of 800 °C while the reject steam and residual hydrogen is recycled back to the feed of the electrolyzer without costly cooling and reheat steps. Preliminary data showing membrane separation performance and thermal stability will be presented.