



***Membrane Reactor for Energy Production:
Potential Materials for Gas Molecules***

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Membrane-based gas/vapor separation technologies have been industrialized and developed into membrane reactors (MRs) to enhance conversion/yield by selective removal of reactants or products for more than three decades due to their superior energy-efficient and environment friendly characteristics.

MRs are made from inorganic materials that separate H₂ molecule at elevated temperatures. Successful application of MRs hydrogen separation technology will allow significant improvement in the performance of several large-scale industrial processes. For example, the MR hydrogen production process, by combining hydrogen separation and high temperature H₂ generation processes into a single compact inorganic MR, has the potential for substantially reducing the capital investment and conversion rate for biomass to energy plants when integrated with power generation cycles.

However, industries demand more robust and productive MRs to meet the harsh conditions in new or emerging applications. The fabrication of MRs consisting of membrane materials and catalytic reactor will likely play the pivotal role to meet the future demands.

This lecture will focus on the progression and development of membrane-based gas separation technologies with the aim to produce next-generation high-performance MRs, including inorganic membrane and inorganic-organic hybrid membrane. The main challenges such as thermal stability and physical aging in MR are then discussed, followed by attractive attempts to suppress them. In additions, both materials are compared in terms of their characteristics, gas separation performance, and techno-economic assessment. Finally, prospects and challenges of membrane-based energy production technology, especially at extremely complex environment are point out. We also outline the directions, challenges and key areas for future R&D in the field of energy production MRs.