

## Catalytic Membrane Reactor for Sustainable Hydrogen Production from Ammonia

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Conventional hydrogen production from ammonia is both energy and process intensive, requiring high temperature and independent purification units. Here, we present a compact process of energy conversion from NH<sub>3</sub> to electricity using a novel membrane reactor, comprised of a dense metallic Pd/Ta composite membrane and Ru/La-Al<sub>2</sub>O<sub>3</sub> pellet catalysts. The fabricated Pd/Ta composite membrane, having ca. 5 times higher H<sub>2</sub> permeability than conventional Pd-Ag membranes, can both lower NH<sub>3</sub> dehydrogenation temperature and completely remove an additional hydrogen purification unit. Compared to a packed-bed reactor without membrane, ammonia conversion improves significantly under pressurized ammonia feed of 5 bar. Main barriers of practical application of Pd/Group V metals as a composite hydrogen permeable membrane, embrittlement and durability issues, are overcome owing to pertinent operating temperatures of ammonia dehydrogenation coupled with membrane separation. The combined results suggest a feasible and less energy/process intensive option for producing hydrogen or electricity from ammonia.