CONCEPT PAPER -1
for KIER International Cooperation Project

Personal Data	Name of PI	Shin-Kun Ryi	Organization	Korea Institute of Energy Research (KIER)
	Department	High temperature energy conversion Lab.	Title	Principle Researcher
	Cell Phone #	+82 10 9897 7573	E-mail	h2membrane@kier.re.kr
Title	Development of high-efficient egg-shell type ammonia decomposition catalyst for CO_2-free hydrogen production			
1. Needs	● Ammonia as clean hydrogen source - Ammonia is receiving great attraction as a resource of CO_2-free clean hydrogen. - Demand of ammonia decomposition catalyst will increase drastically. - New and economical ammonia decomposition catalyst is necessary.			
2. Competition	● Differences and advantages over the current technologies or approaches - Commercial ammonia decomposition catalyst is composed of Ru and very expensive. - Egg-shell type can reduce the amount of Ru and low cost materials replace Ru leading the increase of economic feasibility. - Novel high-active catalyst at low temperature decrease operational costs.			
3. Approach	● Barrier(s) to tackle and how to solve the barriers - High cost : decrease catalyst cost using egg-shell type. - Mechanical Problems of commercial catalysts such as dust rising : development of high mechanical strength supports and then coating the active materials. - Low catalyst activity : development of novel high active catalyst components.			
4. Benefit	● What is the actual benefits expected from the project - Advance of Korean hydrogen production technology in to global hydrogen market. - Training manpower : Training of the next generation scientists and engineers is on of the core component of this project. - State-of-the art technology : characterization, and synthesis methods will be employed to tackle this challenge.			
5. Deliverables	● Key deliverable - Catalyst cost down (1,000 $/kg to 200 $/kg) - Publications and/or Patents			

CONCEPT PAPER -2
for KIER International Cooperation Project

Personal Data	Name of PI	Ji Chan Park	Organization	Korea Institute of Energy Research (KIER)
	Department	Clean Fuel Research Laboratory	Title	Principle Researcher
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Title	Development of highly efficient CO_2 conversion technologies with hybrid nanocatalysts and multi-energy sources			
1. Needs	● Global warming is a critical environmental problem that humanity must address, requiring the development of new efficient and practical conversion processes that can process carbon dioxide on a large scale. ● Because carbon dioxide is so chemically stable, despite many technological developments to date, its reduction still requires a large energy input, and the catalysts and reaction environments developed to date face various limitations. ● There is a need to recognize the limitations of conventional thermochemical and electrochemical CO_2 conversion and explore new research directions (light, combined energy, hybrid catalysts).			
2. Competition	● Thermodynamically, the CO_2 reforming reaction of methane reaches a high equilibrium conversion rate at a high temperature above 800°C, making a high-temperature reaction environment essential and requiring a large amount of energy input. ● Until now, CO_2 reforming of methane has been limited by catalyst stability and selectivity, and in particular, stable and highly active catalysts at high temperatures are required for continuous and rapid conversion of CO_2. ● In electrochemical CO_2 reduction studies, the use of electrical energy alone to convert CO_2 is limited in terms of practicality, i.e., single-pass conversion efficiency (SPCE). ● Solar energy needs to be increasingly harnessed to replace fossil fuel use, and photothermal catalysis could be the most efficient way to harness the sun's light and heat energy.			
3. Approach	● In order to achieve a high CO_2 conversion rate and reduce the reaction temperature, the efficiency and stability of the reaction process need to be improved, and a combined energy input method using light and electricity needs to be considered. ● The amount of energy required to drive the carbon dioxide conversion reaction should be minimized, which can be achieved through the use of efficient catalysts and optimization of reaction conditions (temperature, gas composition, flow rate).			
4. Benefit	● Acquisition of new catalysts and low-energy CO_2 conversion technologies will lead to CCU technology advancements and contribute to the drive toward carbon neutrality. ● It can be applied to various catalytic reaction processes by increasing the efficiency of the reaction even if the same energy is input, thereby improving the productivity of the product obtained.			
5. Deliverables	● Key deliverable - 3 or more optimized hybrid catalysts and associated results - High carbon dioxide conversion rate of more than 95 - Efficiency analysis data - Submit at least one paper to an SCIE journal			