KIER KOREA INSTITUTE OF ENERGY RESEARCH

CONCEPT PAPER

for KIER International Cooperation project

Personal Data	Name of PI	Younghyun Cho	Organization	Korea Institute of Energy Research
	Department	Separation and Conversion Materials Laboratory	Title	Senior Researcher
	Cell Phone #	+82-10-9291-8642	E-mail	yhcho@kier.re.kr
Title	Nanostructured Organic Electrodes for Electrochemical Energy Storage Devices			
Description	● Barrier(s) to tackle Li-ion batteries have become the dominant power sources for portable electronic devices by utilizing transition metal oxides or metal phosphates as the positive electrode (cathode) materials. However, large-scale installations of batteries are incompatible for renewable energy storage and electric propulsion systems due to the usage of expensive metals such as cobalt, driving the development of more sustainable organic electrodes to increase the energy storage capacity per unit cost. Organic electrode materials are composed of inexpensive and earth abundant elements, such as carbon, oxygen, nitrogen, and sulfur. Considerable amount of research efforts have been focused on developing organic electrodes having stable redox reactions from the early development of rechargeable batteries. However, these organic electrode materials suffer from poor cycling stability due to the dissolution of molecules into the electrolyte and low power density due to the low electrical conductivity. Therefore, improving the cycling stability and the power capability without sacrificing the energy density of organic electrodes remains a major challenge in the development of organic batteries. ● Strategy to solve It is expected that the control on the interaction of surface functionalities and optimized nano-architecture designing of the electrodes significantly improve the performance of the organic electrodes including high energy, high power density, and superior cycling stability compared to other organic electrodes. **-Understanding the Role of Functional Groups on Charge Storage Reactions** **-Preparation of Nanostructured Composite Electrodes** **-Assessing Battery Performance of the Organic Composite Electrodes** **-Assessing Redox Capacitor Performance of the Organic Redox Molecules Modified Electrodes**			
Outcomes*	● Specific capacity: >170 mAh/g (Current inorganic cathode: ~150 mAh/g) ● Maximum power density: >100 kW/kg cathode (Current inorganic cathode:~10kW/kg) ● Cycling stability: 80% retention after 10,000 cycles (Accelerated cycling condition) ● Cost down target: $10/kW (Current high-power Li-ion battery: $30/kW) ● CO2 emission abatement: Non-CO2 generating organic source ● Publications and/or Patents: At least three top journals/year			