



HANYANG UNIVERSITY

2019 HISS Research Project

(Solid oxide fuel cell fabricated by electrostatic slurry spray deposition (ESSD))

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Laboratory Research Center Information	
Topics	<ul style="list-style-type: none">■ All-Solid-State lithium batteries<ul style="list-style-type: none">- Effects of binary conductive additives on electrochemical performance of composite cathode for all-solid-state lithium batteries■ Solid oxide fuel cells<ul style="list-style-type: none">- Solid oxide fuel cell fabricated by electrostatic slurry spray deposition (ESSD)
Activities	<ul style="list-style-type: none">■ All-Solid-State lithium batteries<ul style="list-style-type: none">- Design of composition for all-solid-state composite cathode- All-solid-state cell fabrication & assembly- Electrochemical analysis & performance evaluation of all-solid-state cell- Learning of tools such as Scanning Electron Microscope (SEM) etc. for material property analysis■ Solid oxide fuel cells<ul style="list-style-type: none">- Microstructure control to improve catalyst activity and stability- Material synthesis and slurry fabrication for solid oxide fuel cell- Application of electrostatic slurry spray deposition in various fields
Achievement	<ul style="list-style-type: none">■ All-Solid-State lithium batteries<ul style="list-style-type: none">- Proposal for government-funded projects- Projects with major battery companies in Korea (LG Chem., Hyundai motor company)- Publish more than 3 articles per year- Major technology transfer■ Solid oxide fuel cells<ul style="list-style-type: none">- Proposal for government-funded projects- Transfer of technology related to the electrostatic slurry spray deposition to industry- Published a paper in the 2018 nature energy

Pre-requisite & Eligibility	
Academic Background	<ul style="list-style-type: none">■ All-Solid-State lithium batteries & Solid oxide fuel cells<ul style="list-style-type: none">- Materials Science & Engineering- Electrochemistry

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	- Basic of lithium ion batteries & solid oxide fuel cells
Relevant Experience	<ul style="list-style-type: none"> ■ All-Solid-State lithium batteries & Solid oxide fuel cells - Electrochemistry / basic of lithium ion batteries & solid oxide fuel cells (not required but recommended)
Language	<ul style="list-style-type: none"> - English speaking and writing - Beginner-level Korean skills

Objective & Description:	The student is asked to design and build all-solid-state lithium batteries & solid oxide fuel cells based on electrochemical and materials science engineering knowledge. The behavior & phenomenon of the all-solid-state lithium batteries can be observed and understood through the acquired knowledge.		
Project Duration	6 weeks	Project Hours:	minimum 80 hours

	Weekly Topic & Activities	Student Assignment
Schedule:	Week 1 <ul style="list-style-type: none"> ■ All-Solid-State lithium batteries - Introduction - Literature survey - Overview of all-solid-state lithium batteries & Solid oxide fuel cells 	<ul style="list-style-type: none"> ■ All-Solid-State lithium batteries & Solid oxide fuel cells - Report on all-solid-state lithium batteries & Solid oxide fuel cells (<10 pages) - Report on basic principle of electrochemistry
	Week 2 <ul style="list-style-type: none"> ■ All-Solid-State lithium batteries - Design of composite cathode - Fabrication & assembly of all-solid-state cell ■ Solid oxide fuel cells - Synthesis of materials for solid oxide fuel cells fabrication and slurry production 	<ul style="list-style-type: none"> ■ All-Solid-State lithium batteries & Solid oxide fuel cells - Writing down of the experiment report
	Week 3 <ul style="list-style-type: none"> ■ All-Solid-State lithium batteries - Design of composite cathode - Fabrication & assembly of all-solid-state cell - Testing and system optimization ■ Solid oxide fuel cells - Half-cell fabricated by electrostatic slurry deposition 	<ul style="list-style-type: none"> ■ All-Solid-State lithium batteries & Solid oxide fuel cells - Writing down of the experiment report
	Week 4 <ul style="list-style-type: none"> ■ All-Solid-State lithium batteries - Electrochemical analysis (Charge-discharge characteristics, Electrochemical impedance spectroscopy) ■ Solid oxide fuel cells 	<ul style="list-style-type: none"> ■ All-Solid-State lithium batteries & Solid oxide fuel cells - Writing down of the experiment report



	- Single-cell fabricated by electrostatic slurry deposition	
Week 5	<ul style="list-style-type: none"> ■ All-Solid-State lithium batteries <ul style="list-style-type: none"> - Materials property analysis (Microstructure observation on SEM analysis) ■ Solid oxide fuel cells <ul style="list-style-type: none"> - Materials property analysis (Microstructure observation on SEM analysis & XRD) 	<ul style="list-style-type: none"> ■ All-Solid-State lithium batteries & Solid oxide fuel cells <ul style="list-style-type: none"> - Writing down of the experiment report
Week 6	<ul style="list-style-type: none"> ■ All-Solid-State lithium batteries <ul style="list-style-type: none"> - Interpret the acquired data with electrochemical & materials property analysis - Preparation for final presentation ■ Solid oxide fuel cells <ul style="list-style-type: none"> - Electrochemical analysis (Electrochemical impedance spectroscopy) - Preparation for final presentation 	<ul style="list-style-type: none"> ■ All-Solid-State lithium batteries & Solid oxide fuel cells <ul style="list-style-type: none"> - Final report for the experiments (<10 pages) - 15min. oral presentation

	Attendance	Report including weekly report	Final Presentation or Paper
Evaluation	30%	40%	30%