### Hanyang International Summer School
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## 2019 HISS Research Project
(Solid oxide fuel cell fabricated by electrostatic slurry spray deposition (ESSD))

### Professor:
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**Department:** Materials Science and Engineering
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### Laboratory Research Center Information

| Topics | All-Solid-State lithium batteries  
- Effects of binary conductive additives on electrochemical performance of composite cathode for all-solid-state lithium batteries  
- Solid oxide fuel cells  
- Solid oxide fuel cell fabricated by electrostatic slurry spray deposition (ESSD) |
|---|---|
| Activities | All-Solid-State lithium batteries  
- 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  
- 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 | All-Solid-State lithium batteries  
- 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  
- 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 | All-Solid-State lithium batteries & Solid oxide fuel cells  
- Materials Science & Engineering  
- Electrochemistry |

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**Relevant Experience**

- Basic of lithium ion batteries & solid oxide fuel cells

- All-Solid-State lithium batteries & Solid oxide fuel cells
- Electrochemistry / basic of lithium ion batteries & solid oxide fuel cells (not required but recommended)

**Language**

- 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

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**Weekly Topic & Activities**

**Student Assignment**

**Week 1**

- All-Solid-State lithium batteries
  - Introduction
  - Literature survey
  - Overview of all-solid-state lithium batteries & Solid oxide fuel cells

- All-Solid-State lithium batteries & Solid oxide fuel cells
  - Report on all-solid-state lithium batteries & Solid oxide fuel cells (<10 pages)
  - Report on basin principle of electrochemistry

**Week 2**

- 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

- All-Solid-State lithium batteries & Solid oxide fuel cells
  - Writing down of the experiment report

**Week 3**

- 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

- All-Solid-State lithium batteries & Solid oxide fuel cells
  - Writing down of the experiment report

**Week 4**

- All-Solid-State lithium batteries
  - Electrochemical analysis (Charge-discharge characteristics, Electrochemical impedance spectroscopy)

- Solid oxide fuel cells

- All-Solid-State lithium batteries & Solid oxide fuel cells
  - Writing down of the experiment report
<table>
<thead>
<tr>
<th>Week 5</th>
<th>Week 6</th>
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<tbody>
<tr>
<td>- Single-cell fabricated by electrostatic slurry deposition</td>
<td>- All-Solid-State lithium batteries &amp; Solid oxide fuel cells</td>
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<td>- Materials property analysis (Microstructure observation on SEM analysis)</td>
<td>- Writing down of the experiment report</td>
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<tr>
<td>- Materials property analysis (Microstructure observation on SEM analysis &amp; XRD)</td>
<td>- Electrochemical analysis (Electrochemical impedance spectroscopy)</td>
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<tr>
<td>- Preparation for final presentation</td>
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<th>Evaluation</th>
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