Low Temperature NH$_3$ Cracking Membrane Reactor for H$_2$ Generation

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**Co-PI:** Gang Wu, PhD, SUNY at Buffalo

**Project Vision**
- Develop H$_2$ separation membrane and novel catalyst for low temperature NH$_3$ cracking
- Integrate catalyst and membrane into a membrane reactor system
- Build safe, low-cost, on-demand H$_2$ refueling stations

**Project Impact**
- Reduce cost barriers for H$_2$ refueling stations
- Reduce GHG emissions
- Maintain US leadership in $15B fuel cell market
Innovation and Objectives

Innovation
• Innovative H₂ separation membrane and novel catalyst for low temperature NH₃ cracking (AC-MR)
• Integration of catalyst and membrane into a membrane reactor system
• Enables small on-demand H₂ refueling stations

Technical Objectives
Phase I -- Confirm the feasibility of low temperature AC-MR system
Phase II -- Demonstrate prototype AC-MR producing 10 L H₂/min
Phase IIIS -- Establish partnership to commercialize AC-MR technology

Tech-to-Market Strategy
• Partnership with NYSERDA, H₂ generation and supply companies, fuel cell and FCEV manufacturers
• The first market: existing gas stations, H₂ refueling stations
• License and/or co-development
Innovation and Objectives

**Project History**
- Bettergy Corp. holds proprietary technologies in zeolite membrane separation and MR field.
- SUNY—Buffalo has strong expertise in catalyst synthesis and characterization.

**Proposed Targets**

<table>
<thead>
<tr>
<th>Metric</th>
<th>State of the art</th>
<th>Proposed</th>
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</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>700-1100 °C</td>
<td>&lt;450 °C</td>
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<tr>
<td>Conversion</td>
<td>99%</td>
<td>&gt;99%</td>
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<tr>
<td>Energy efficiency</td>
<td>~60</td>
<td>&gt;80%</td>
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<tr>
<td>Cost per capacity</td>
<td>12,500 per$/kg/day</td>
<td>8,141 per$/kg/day</td>
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<tr>
<td>Lifetime</td>
<td>2-5 year</td>
<td>&gt;10 year</td>
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**Anticipated Challenges**

<table>
<thead>
<tr>
<th>Technical risks</th>
<th>Mitigation</th>
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<tbody>
<tr>
<td>Heat management</td>
<td>Flameless combustion of retentate gas to provide heat</td>
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<tr>
<td>Membrane sealing</td>
<td>Modularized tubular design</td>
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</tbody>
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**Desirable Partnerships**
- NYSERDA – supporting green energy in New York State
- H₂ generation equipment manufacturers/suppliers
- Fuel cell manufacturers
- FCEV manufacturers
- Fuel station developers and owners