Foundational Research for H2@Scale: Energy Materials Network Consortia

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EMN creates a nexus of industry, government, & laboratory stakeholders with resources focused on accelerating materials innovation into clean-energy products.

ElectroCat

The Electrocatalysis Consortium (ElectroCat) is using national lab resources and capabilities such as Argonne’s High-Throughput Research facility ( pictured) and Los Alamos’ ability to design and synthesize catalysts to speed the development process of PGM-free electrocatalysts for fuel cells.

Photo credit: Argonne National Laboratory
A Platform for Accelerated R&D

The Energy Materials Network (EMN) aims to dramatically decrease time-to-market for advanced materials that are critical to many clean energy technologies.

**Energy Materials Network**
U.S. Department of Energy

**WORLD-CLASS INNOVATION**
EMN is fueling U.S. industry with leading scientific and technical capabilities, data, and tools, and helping deliver innovative clean energy products to the world marketplace through its network of national lab-led consortia.

**CLEAR POINTS OF ENGAGEMENT**
In building an enduring, accessible network, EMN offers industry clear points of engagement and streamlined access to national lab resources by providing technical support, collaboration tools, and data platforms.

**RAPID SCALE-UP**
EMN is addressing market deployment barriers and getting new technologies to market faster by better integrating all phases of the materials development cycle, from discovery through deployment.

**EMN’s initial consortia are focusing on targeted materials tracks aligned with some of industry’s most pressing clean energy materials challenges.**

**Cutting-edge materials research for critical energy technologies**
The EMN relies on \textit{industry pull} and \textit{scientific push} to work together in the accelerated R&D of important clean energy technologies.
The EMN Pioneer Consortia

Energy Materials Network
U.S. Department of Energy

1. **World Class Materials Capability Network**
   - Predictive Simulation Across Scales
   - Synthesis & Characterization
   - Rapid Screening
   - End Use Performance
   - Process Scalability
   - Process Control
   - Real-time Characterization
   - Reliability Validation
   - Data Management & Informatics

2. **Data & Tools Collaboration**
3. **Clear Point of Engagement**
4. **Streamlined Access**

*EMN consortia focus on critical clean energy challenges*
Supporting H2@Scale Research Needs

- **PGM-free catalysts for fuel cells are critical for cost-reductions needed for large-scale market penetration**

- **Breakthrough H₂ storage materials are key to large-scale H₂ energy & possible future on-board storage**

- **H2@Scale depends on a future portfolio of large-scale, low-cost, sustainable H₂O splitting options**
ElectroCat: Fuel Cell PGM-Free Electrocatalysts

Accelerating the discovery & development of innovative catalyst and electrode materials critical to advanced platinum group metal-free fuel cell technologies

- Comprising world-class capabilities and expertise in:
  - catalyst synthesis, characterization, processing, & manufacturing
  - high-throughput, combinatorial techniques
  - advanced computational tools

Synthesis, processing and manufacturing

Characterization and Synthesis

Computation, Modeling & Data Management

Website: http://www.electrocat.org/
HyMARC: Breakthrough H₂ Storage Materials

HyMARC will provide capabilities and foundational understanding of phenomena governing thermodynamics and kinetics limiting the development of solid-state hydrogen storage materials.

- Delivering community tools and capabilities:
  - Computational models and databases for high-throughput materials screening
  - New characterization tools and methods (surface, bulk, soft X-ray, synchrotron)
  - Tailorable synthetic platforms for probing nanoscale phenomena

Website: https://hymarc.org/

Controlled synthesis

In situ characterization
HydroGEN: Advanced H₂O Splitting Materials

Accelerating discovery & development of innovative materials critical to advanced technologies for sustainable H₂ production, including:

- **Advanced high- and low-temperature electrochemical conversion**
- **Direct photoelectrochemical solar water splitting**
- **Direct solar thermochemical water splitting**

➢ Comprising more than 80 unique, world-class capabilities/expertise in materials theory/computation, synthesis, characterization & analysis:

**Materials Theory/Computation**
- LLNL
  - Bulk & interfacial models of aqueous electrolytes
  - LAMMPS classic molecular dynamics modeling relevant to H₂O splitting

**Advanced Materials Synthesis**
- NREL
  - High-throughput spray pyrolysis system for electrode fabrication

**Characterization & Analytics**
- SNL
  - Stagnation flow reactor to evaluate kinetics of redox material at high-T
  - Conformal ultrathin TiO₂ ALD coating on bulk nanoporous gold
  
  TAP reactor for extracting quantitative kinetic data

Website: https://www.h2awsm.org/
Streamlined Access to Materials Innovations

The EMN leverages National Lab resources to foster foundational materials R&D for important clean energy applications.

The EMN framework facilitates streamlined access for industry and academic stakeholders.

EMN framework allows for flexibility in establishing materials-specific consortia.

but each consortium must satisfy the core EMN framework requirements.

EMN framework leverages National Lab resources to foster foundational materials R&D for important clean energy applications.

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The EMN innovation ecosystem facilitates foundational H2@Scale R&D.
Facilitating H2@Scale Foundational R&D

Single points of contact facilitate stakeholder/consortia interactions

ElectroCat
Electrocatalysis Consortium

HydroGEN
Advanced Water Splitting Materials

HyMARC
Hydrogen Materials Advanced Research Consortium

Music Loop
Value Added Applications

INDUSTRY

Concierge
Single Point of Contact

EMN Consortium’s National Lab Capabilities Network

Lab 1
Lab Expert Team

Lab 2
Lab Expert Team

Lab X
Lab Expert Team

Each Consortium Lab assigns an Expert Team covering 3 areas

Technical Capabilities
Technology Transfer and Agreement
Data Management

“Can you help me develop my products FASTER?”

Lab 1

Lab 2

Lab X
THANK YOU!

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