

Topic: N162-107

TDA Research, Inc.

Improve Proton Exchange Membrane (PEM) Electrocatalysts

TDA is a technology development company that designs a variety of materials and systems, including catalysts and sorbents. We have developed an electrocatalyst which reduces the platinum loading for use in electrolyzers to generate breathing oxygen onboard submarines. By using TDA's novel carbon supports we can reduce the precious metal content by a factor of ten compared to the electrocatalysts currently in use within the Navy and proportionally reduce the cost, while maintaining the same activity and system performance. Our technology's advantage is in its cost, which targets a significant cost reduction per electrolysis cell stack correlating to savings on the order of magnitude of \$100K's per unit and millions of dollars in total to the Navy. We have performed rigorous testing in house and have also had samples tested by our collaborator Nel, a leader in the production of electrolyzers. We are currently looking for a Navy customer to fund environmental qualification testing of an electrolysis cell stack utilizing this novel catalyst, which will allow for realization of the significant acquisition cost savings to NAVSEA.

**Technology Category Alignment:**

Ground and Sea Platforms

Battlespace Environments

Energy & Power Technologies

**Contact:**

Dr. Girish Srinivas

[gkrinivas@tda.com](mailto:gkrinivas@tda.com)

(303) 748-7153

<http://tda.com/>

**SYSCOM:** NAVSEA

**Contract:** N68335-19-C-0118

 Corporate Brochure: [https://navystp.com/vtm/open\\_file?type=brochure&id=N68335-19-C-0118](https://navystp.com/vtm/open_file?type=brochure&id=N68335-19-C-0118)

 Tech Talk: [https://www.youtube.com/watch?v=tlr\\_8tGnc8k](https://www.youtube.com/watch?v=tlr_8tGnc8k)

# Department of the Navy SBIR/STTR Transition Program

DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.

NAVSEA #

Topic # N162-107

Advanced PEM Electrocatalysts for Submarine Oxygen Generators

TDA Research, Inc.

## WHO

**SYSCOM:** NAVSEA

**Sponsoring Program:** NAVSEA

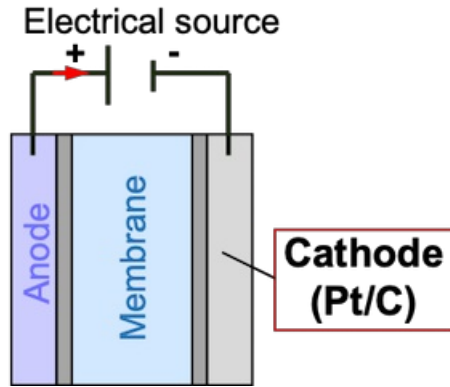
**Transition Target:** PMS450 and PMS397

**TPOC:**  
(215)897-7218

**Other transition opportunities:**

These improvements have direct importance to commercial PEM electrolyzers and PEM fuel cells, which are utilized by UUVs (PMS406, etc.)

**Notes:** TDA's catalyst (top) is Pt/C with an order of magnitude lower Pt content than commercial catalysts to substantially reduce cost. It is used in electrolyzer cathodes to produce breathing oxygen onboard submarines (bottom)



Copyright, 2020, TDA Research, Inc.

## WHAT

**Operational Need and Improvement:** Submarines currently use electrolyzers for onboard oxygen generation via water splitting. The state-of-the-art cathode catalysts use platinum (Pt), as it shows high activity and stability. However, Pt is a very expensive noble metal. TDA has developed a Pt/C catalyst that maintains high activity with an order of magnitude lower Pt loading to dramatically reduce the cost of these systems.

**Specifications Required:** While ultimately the electrolysis cell stack utilizing this novel electrocatalyst needs to comply with all military environmental qualification standards, the focus of this effort was a factor of 10 reduction in Pt loading without any loss in activity/performance, which has been achieved.

**Technology Developed:** TDA's novel carbon supports allow very small Pt particles to be dispersed on the support, increasing the available Pt surface area with a lower total volume of Pt. This has allowed us to reduce the Pt content of our catalyst by a factor of 10, thereby significantly reducing the cost of the electrocatalyst and thus the cost of the electrolysis cell stack.

**Warfighter Value:** As the Pt catalyst is one of the primary costs associated with the electrolyzer cell stacks used onboard submarines, TDA's catalyst will drastically reduce the cost of operating these systems. Anticipated cost savings are on the order of magnitude of \$100K's per electrolysis cell stack and \$10M's in total to the Navy.

## WHEN

**Contract Number:** N68335-19-C-0118 **Ending on:** March 8, 2021

| Milestone   | Risk Level | Measure of Success   | Ending TRL | Date       |
|---|------------|--|------------|------------|
| Prepare High Activity Catalyst with <0.1 mg Pt/cm <sup>2</sup>          | N/A        | Performance Comparable to Commercial 1 mg Pt/cm <sup>2</sup> Catalysts | 3          | March 2017 |
| Optimize Carbon Support   | N/A        | Improved Performance of Previous <0.1 mg Pt/cm <sup>2</sup> Catalyst   | 3          | March 2019 |
| Validate Performance in Nel's Electrolyzer Stacks                       | N/A        | TDA's Catalysts Showed Good Performance in Third Party Testing         | 4          | May 2019   |
| Scale Up Catalyst Production  | N/A        | Produced 50g Batch of Catalyst Matching Lab-Scale Performance          | 4          | May 2020   |
| Demonstrate Activity and Stability in Existing Navy Electrolyzer Stacks | Med        | Performance Matches that of Commercial Catalysts                       | 5          | March 2021 |

## HOW

**Projected Business Model:** TDA has the equipment to produce commercial scale batches of catalyst, which will be sold to a commercial producer of electrolyzer stacks (such as our collaborator Nel) for production of membrane electrode assemblies (MEAs) that will be included in the electrolysis cell stacks they provide to the Navy.

**Company Objectives:** TDA has previously produced and sold catalysts to the military and will further develop this electrocatalyst technology to be a leader in the production of Pt/C for Navy electrolyzer stacks.

**Potential Commercial Applications:** This catalyst will be of use in existing and future Navy submarines, which utilize electrolysis for generation of breathing oxygen.

Additionally, These improvements have direct importance to commercial PEM electrolyzers and PEM fuel cells. PEM electrolyzers and PEM fuel cells compete in markets such as automotive propulsion as an alternative to gasoline-powered engines, supplying power to our nation's electrical grid, and even use as a clean water-splitting energy source as an alternative to fossil fuel-based power generation. Adaptations of these improvements are also relevant for use in solar photo electrochemical cells in energy generation and all other markets in which solar cells compete.

**Contact:** Dr. Girish Srinivas, Vice President  
[gsrinivas@tda.com](mailto:gsrinivas@tda.com) 303-748-7153