Title:	Los Alamos National Laboratory: Request for Information (RFI) – Call for Commercialization Partners on behalf of the Department of Energy's Fuel Cell Technologies Office (FCTO) L'Innovator Pilot Program
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Los Alamos National Laboratory
Request for Information (RFI) – Call for Commercialization Partners
On behalf of the Department of Energy's Fuel Cell Technologies Office (FCTO)
L'Innovator Pilot Program

The U.S. Department of Energy's (DOE's) Fuel Cell Technologies Office is implementing an innovative approach to accelerate the commercialization of ***cutting-edge innovation*** in hydrogen and fuel cell technologies developed at its national labs. These innovations can reduce costs and improve the durability of fuel cells, creating a strong competitive edge for technology developers in an emerging industry. With an over $100 billion market across sectors including stationary power, transportation, industrial, and portable power, and multiple applications such as energy storage, backup power/resiliency, material handling equipment, military applications, and vehicles, the industry is poised for significant growth in the next few years. In fact, over 60,000 fuel cells were shipped worldwide in 2015 with a roughly 30% growth in shipments every year since 2010, clearly demonstrating market uptake and value.[1]

With a goal of enabling a robust domestic industry and supply base in the emerging area of hydrogen and fuel cell technologies, the L'Innovator (which stands for "Lab Innovator") Pilot Program is designed to address specific challenges associated with the transition of hydrogen and fuel cell technologies from DOE's national laboratories into the commercial marketplace. The approach will take lab-generated innovation to the private sector either through newly formed companies (NewCos) or existing companies. FCTO and the participating DOE national labs are establishing unique bundles of relevant intellectual property (IP) to be developed through the L'Innovator Pilot Program based on an in-depth understanding of the technological state-of-the-art and the needs of early and emerging fuel cell markets. A key feature of the L'Innovator Pilot Program is cost-share provided by DOE to its national lab researchers to attract private investment and enable effective and accelerated technology transfer of the IP through collaboration with a manufacturing and commercialization partner. Interest by potential manufacturing and commercialization partner(s) is solicited through this RFI. ***Please note that this Call for Commercialization Partners is <u>not</u> a procurement.***

The purpose of the L'Innovator is to assemble unique, state-of-the-art IP bundles developed at the national labs that aggregate synergistic technologies in furtherance of the emerging hydrogen and fuel cell market. The first L'Innovator IP bundle consists of Oxygen Reduction Reaction (ORR) Catalyst technology developed at Brookhaven National Laboratory (BNL), combined with Membrane Electrode Assembly (MEA) technology developed at Los Alamos National Laboratory (LANL).

To further the implementation of the L'Innovator Pilot Program, LANL is serving as the lead institution in issuing this Call for Commercialization Partners. The specific purpose of this Call is to notify

[1] 2015 DOE Fuel Cell Technologies Market Report; https://energy.gov/eere/fuelcells/downloads/2015-fuel-cell-technologies-market-report

potentially interested parties regarding the commercialization opportunity associated with the initial L'Innovator IP bundle and to set forth the process for expressing such interest. LANL will also lead the effort to develop any corresponding collaboration agreement(s), such as a Cooperative Research and Development Agreement (CRADA) in support of transitioning this technology into the commercial marketplace. The goal of this RFI is to identify the most qualified industrial partner(s) willing to co-invest in the development and ultimate manufacturing and commercialization of novel hydrogen and fuel cell technologies, with specific emphasis on a domestically manufactured MEA, in support of U.S. industry and economic competitiveness.

Los Alamos National Security, LLC (LANS) is the manager and operator of the Los Alamos National Laboratory (LANL) for the U.S. Department of Energy's (DOE's) National Nuclear Security Administration under contract DE-AC52-06NA25396. LANS is a mission-centric Federally Funded Research and Development Center (FFRDC) focused on solving the most critical national security challenges through science and engineering for both government and private sector customers. On behalf of its federal sponsor (DOE-FCTO), LANS will manage the issuance of the Call for Commercialization Partners and the corresponding selection process for identifying the most qualified industry partner(s) to assist with the commercial deployment of the initial L'Innovator IP bundle described herein.

L'INNOVATOR PILOT PROGRAM OVERVIEW

The L'Innovator aims to address specific challenges for investors and companies in the deployment of hydrogen and fuel cell technologies. For example, there are few mechanisms that assist manufacturers with developing a Minimum Viable Product (MVP) that demonstrates commercial feasibility of lab IP before they make significant commitments. Also, while national labs often license IP individually, it is not as common to see portfolios of synergistic technology bundled together by multiple laboratories. The L'Innovator is a 'spin out' approach which will take lab-generated innovation out to the private sector either through NewCos or existing companies that engage through this mechanism and agree to the proposed terms. ***A key objective of this Pilot Program is to attract private investment and to create new and expanded opportunities for manufacturing in the United States.***

The framework of the L'Innovator Pilot Program enables prospective manufacturing companies and investors to:

- Access IP bundles from various labs consisting of highly promising hydrogen/fuel cell technologies via a streamlined process for engagement, including the corresponding contractual mechanisms.
- Access support from national labs in the development and demonstration of a MVP, co-funded by the DOE.

TECHNOLOGY DESCRIPTION

For the initial L'Innovator IP bundle, BNL's novel ORR core shell catalyst will be integrated into LANL's advanced MEA technology to optimize the fuel cell performance and durability. This IP bundle reflects ***highly innovative technology*** that could significantly reduce the cost and improve the durability of fuel cell systems, surpassing the current state-of-the-art and providing a competitive edge to future developers and end-users. Each of these technologies is described in further detail below:

Membrane Electrode Assembly - Researchers at LANL have developed non-aqueous perfluorosulfonic acid dispersions for advanced fuel cell electrode processing. The non-aqueous polymer dispersion provides controlled hydrophilicity to produce the optimum distribution of catalyst nanoparticles and ionomeric binder for the preparation of fuel cell electrodes, which cannot be obtained

by conventional aqueous dispersions. The LANL dispersion technology significantly improves the durability of the MEA during dynamic fuel cell operating conditions without sacrificing the performance.[2] Moreover, the uniform distribution of catalyst particles in the fuel cell electrode prevents membrane failure by removing hot spots in the electrode layer (Fig. 1).[3] The advanced LANL MEA technology is particularly useful for the preparation of fuel cell electrodes using low Pt-loaded (alloy) catalysts and/or highly graphitic carbon supports where the fuel cell performance and durability are limited with conventional MEA fabrication techniques.

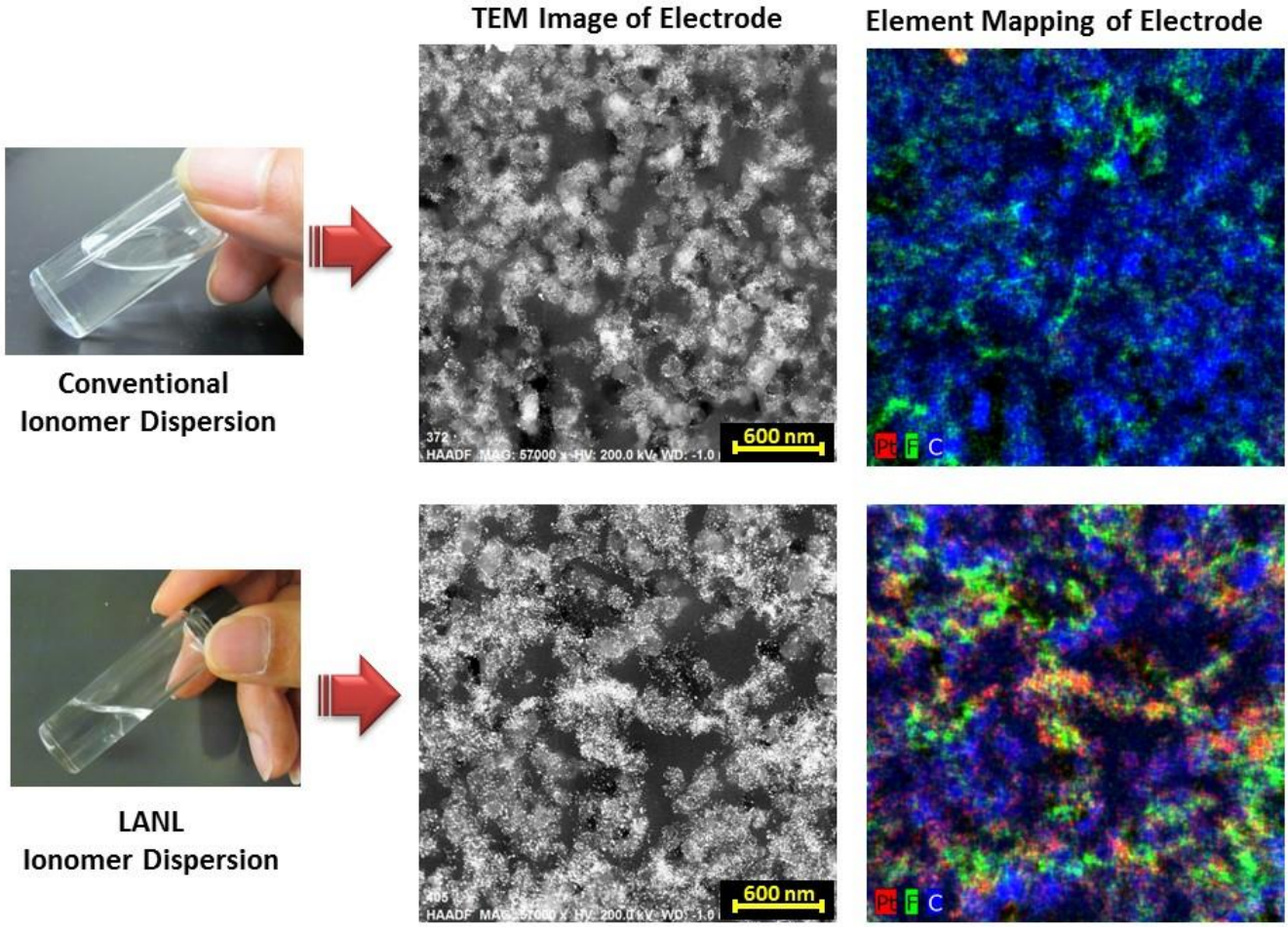

Fig. 1. Comparison of fuel cell electrode morphology prepared from both conventional and LANL's technologies. Element mapping indicates that Pt nanoparticles (denoted in red in element mapping) are more uniformly distributed in the LANL-developed electrodes. TEM: courtesy of Karren More at Oak Ridge National Laboratory.

[2] *PCCP*, 2014, 16, (13), pp 5927-5932.

[3] *J. Electrochem. Soc.*, 2014, 161 (12), pp F1154-F1162.

Core Shell Catalyst - Researchers at BNL have developed an ultralow-platinum electrocatalyst design that significantly decreases the platinum content of the cathode ***by an order of magnitude*** while maintaining cathode performance. [4] In addition, the advances have led to improved durability of the oxygen reduction reaction (ORR) catalyst. The BNL method uses an advanced core-shell catalyst design in which catalytically active platinum monolayers are deposited on stable nanoparticle cores of palladium to form Pd@Pt nano-catalysts that enhance Pt specific activity and raise Pt mass activity, as well as overall Pt group metal mass activity. The BNL-produced catalysts incorporated into a fuel cell cathode and integrated into a full membrane electrode assembly gave improved Pt mass activity compared to a standard Pt catalyst, and greatly improved durability under potential cycling up to 100,000 cycles.

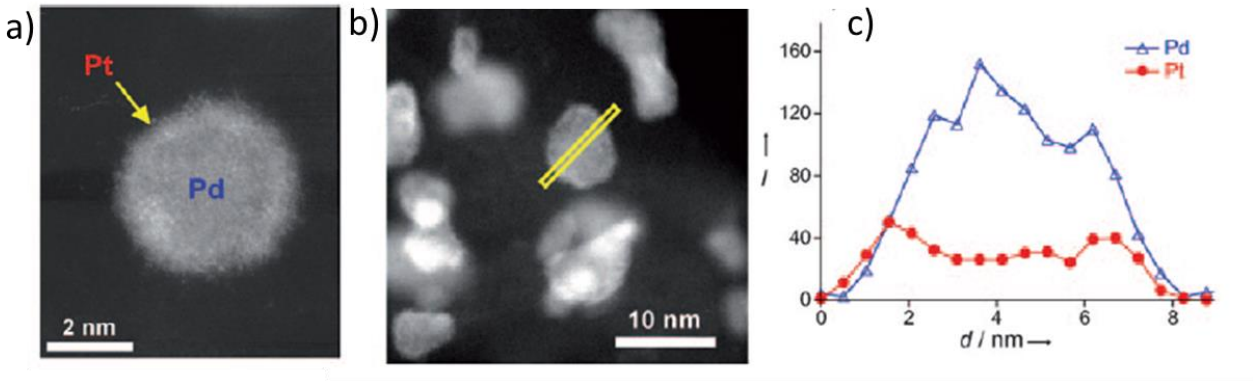

Fig. 2. a) and b) High Angle Annular Dark Field (HAADF) images of core-shell electrocatalyst samples at different magnifications. Pt monolayer shells on Pd cores are visible by the Z-contrast HAADF imaging; c) Distribution of Pt and Pd through a single nanoparticle along the line scan marked in (b), using Energy Dispersive X-ray Spectroscopy (EDS). The scan shows the expected peaking of Pt at the edges due to edge-on profiling of the Pt monolayer, while the Pd core profile peaks in the center of the nanoparticle.

The unique features associated with this first set of bundled L'Innovator IP include the following:

- **Performance/Durability** – the aggregated LANL and BNL technologies comprise the unique combined core shell catalyst and MEA fabrication approach with the potential for the highest fuel cell performance and durability demonstrated to date.
- **Cost –** potential for the lowest cost to date due to low platinum group metal (PGM) content and optimized MEA performance (e.g. The aggregated LANL and BNL technologies demonstrated the Pt loading of fuel cell electrodes can be reduced 2-4 times compared to state-of-the-art MEAs without performance sacrifice).
- **Breadth of Applications** – applicability to both near-term early markets: backup power and material handling (e.g. forklifts); and long-term markets: automotive and transportation.
- **Existing Supply Chain** – BNL's ORR core shell catalyst is available through Tier 1 catalyst suppliers who have previously licensed the underlying technology.

[4] Publications:
1. *ACS Catal.*, 2016, 6 (3), pp 1578–1583
2. *Nature Communications*, 2012, **3**, Article 1115

The primary objective of this Call for Commercial Partners is to accelerate the timeline for transitioning these technologies from the laboratory environment into the commercial marketplace for broad deployment and to boost the domestic fuel cell component manufacturing and supplier base, to the benefit of both U.S. industry and taxpayers. DOE's FCTO, in conjunction with both LANL and BNL, believe that a commercial partner with the requisite experience, manufacturing capabilities, commitment and investment potential will be extremely beneficial in understanding the market realities and requirements for successful early adoption of these cutting-edge technologies. Consequently, the laboratories are seeking one or more collaborative development and licensing partners to assist with the commercial deployment objectives, including the creation of a Minimum Viable Product.

Below you will find the following: 1) a listing of the relevant Intellectual Property available for licensing; 2) details regarding the information that we are requesting in the form of a Letter of Interest; and 3) information regarding the next steps in the Commercialization Call process.

INITIAL BUNDLE OF L'INNOVATOR INTELLECTUAL PROPERTY

Los Alamos National Laboratory:

- **U.S. Patent 9,093,685** entitled "Method of Making Membrane Electrode Assemblies," issued July 28, 2015, Y.S. Kim et al.
- **U.S. Patent 7,981,319** entitled "Non-Aqueous Liquid Compositions Comprising Ion Exchange Polymers," issued July 19, 2011, Y.S. Kim et al.
- **U.S. Patent 8,236,207** entitled "Non-Aqueous Liquid Compositions Comprising Ion Exchange Polymers," issued August 7, 2012, Y.S. Kim et al.
- **U.S. Patent 8,394,298** entitled "Non-Aqueous Liquid Compositions Comprising Ion Exchange Polymers," issued March 12, 2013, Y.S. Kim et al.

Brookhaven National Laboratory:

- **U.S. Patent 7,691,780** entitled "Platinum- and Platinum Alloy-Coated Palladium and Palladium Alloy Particles and Uses Thereof", issued April 6, 2010, R. Adzic et al.
- **U.S. Patent 7,855,021** entitled "Electrocatalysts having Platinum Monolayers on Palladium, Palladium Alloy, and Gold Alloy Core-Shell Nanoparticles, and Uses Thereof", issued February 21, 2010, R. Adzic et al.

Please note that the U.S. Government retains a worldwide, royalty-free, non-exclusive right to practice or have practiced any LANS-owned or BNL-owned patents and/or copyrighted software in the performance of work on behalf of the U.S. Government. Accordingly, any and all partners will have open access to any LANS or BNL patents and copyrights in performance of a federal Government contract. Such retained rights are not applicable to any commercial application of the technology and are strictly limited to applications for or on behalf of the U.S. Government.

COMMERCIAL LICENSING

In order to provide the necessary freedom to operate to the selected partner(s), LANL and BNL will provide non-exclusive license rights to the aforementioned list of background intellectual property (BIP) for reasonable terms and conditions. By virtue of the statutory rights included in any resultant L'Innovator CRADA(s), the selected partner(s) will have the first right of refusal

under the CRADA Option Agreement to exclusively license new foreground IP developed through the L'Innovator for a period of six (6) months following the termination or expiration of the CRADA.

Thus, it is the intent of the participating laboratories to provide a comprehensive suite of license rights to the selected partner(s) for both background and foreground IP relevant to the L'Innovator Pilot Program. Please note that in accordance with the Interlab Agreement previously executed between LANL and BNL, LANL is authorized to serve as the licensing agent for this IP bundle. As the licensing agent responsible for administering this L'Innovator IP bundle, LANS is authorized to grant licenses to its own IP, in addition to that of BNL, in an effort to streamline and improve technology licensing out of the national labs participating in the L'Innovator Pilot Program.

CALL FOR COMMERCIALIZATION PARNTER(S)

By virtue of the issuance of this Call, LANS is opening this formal Request for Information to commercial entities in order to gauge the level of interest and potential for collaboration and/or licensing to achieve commercialization and deployment of the initial L'Innovator IP bundle (LANL's MEA technology integrated with BNL's ORR Core Shell Catalyst). This offering is made without prejudice to any form of agreement, collaborative arrangement, alliance, number of entities, or partnering mechanism.

Those companies interested in pursuing this commercialization opportunity should direct a Letter of Interest (LOI), as well as any questions or comments, to the undersigned on or before 11:59 PM MDT on February 28, 2017.

Commercial Call Timeline:

Issue RFI - Call for Commercialization Partner(s)	January 19, 2017
Letter of Interest (LOI) Submission Deadline	**February 28, 2017**
Execution of Non-Disclosure Agreements (NDAs)	March 21, 2017
Distribution of Technical Information Packages	March 24, 2017
Full Proposals / Business Plans Due to LANL	April 21, 2017

Letter of Interest:

The L'Innovator Team will select the most qualified commercial partner(s) (either NewCo or existing company) to assist with the development and deployment of the MVP targeting eventual market penetration through a competitive call for proposals—the Letter of Interest being the first step in that process.

Your Letter of Interest should include the following information:

1. Description of your company and its mission;
2. Explanation of the company's interest in the technology and its relevance to the company's goals and existing product offering(s);
3. Demonstrated experience in developing, manufacturing, and marketing a technology in one or more technology areas relevant to the IP bundle;
4. Demonstrated significant financial backing and investment interest;
5. A brief description of the company's financial and human resources available for commercializing this technology;

Letter of Interest Cont.:

6. A brief description of the company's relevant facilities/capabilities or access to facilities and equipment required for manufacturing and scale up of the technology;
7. An outline of how the company will provide cost share for the development, manufacturing, and demonstration of a MVP;
8. Anticipated project lead (product champion within your organization) and a brief outline of the company's commercialization strategy;
9. A concise description of your company's proposed customer set and end users, including the strategy for developing a supply base to support the emerging hydrogen and fuel cell market; and
10. A list of any questions that you may have that you would like to have answered prior to the deadline for submitting a full proposal / business plan (due April 21, 2017). *Note: the answers to these questions will be provided to all interested parties to ensure the fair and equitable sharing of information with all parties.*

MINIMUM REQUIREMENTS / PREFERRED PARTNER ATTRIBUTES:

- Demonstrated experience commercializing related technologies.
- Financial resources / cost share commitment (50% matching of the DOE-FCTO investment, which is anticipated to be approximately $1 million to $2 million directed at MVP development (i.e., if DOE-FCTO provides $1 million, the company would also provide $1 million).
- Relevant manufacturing capabilities, including a tangible U.S. manufacturing presence, as well as, an explicit commitment from the company to substantially manufacture in the U.S.
- A concise description of your company's proposed customer set and end users, including the strategy for developing a supply base to support the emerging hydrogen and fuel cell market.

WHAT WE ARE REQUESTING

If you are interested in exploring this commercialization opportunity, please submit the required Letter of Interest on or before **February 28, 2017**. Your LOI should include, at a minimum, the items listed above; however, you are welcome to include any additional information regarding your company (brochures, product information, etc.) that may help us evaluate your interest and suitability as a commercialization partner. ***Note: please properly mark any information that your company considers proprietary or business-sensitive. LANS will supply a Non-Disclosure Agreement (NDA) to companies that require such protection. NDAs with Non-U.S. companies will require additional time to process due to export control requirements.***

We look forward to reviewing your ideas on how together we can rapidly advance this technology towards the commercial marketplace and accelerate deployment to the benefit of the U.S. economy. Please respond by email to ljbb@lanl.gov, or call Laura Barber at (505) 667-9266.

In order for your Letter of Interest to be considered responsive, it must be received by ***11:59 PM MDT on February 28, 2017***. Letters may be sent to the contacts listed below or submitted as an attachment via email. You will be contacted shortly after receipt of your company's LOI to provide additional information regarding the next steps in the commercialization partner selection process.

LANL Business Development Contacts – Richard P. Feynman Center for Innovation:

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