

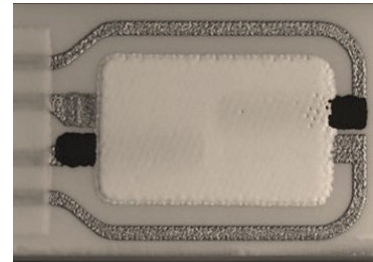
DynAmmo

GAS SENSORS



REQUEST FOR INFORMATION

Commercialization Opportunity



DynAmmo Gas Sensors: A multi-electrode array sensor for continuous monitoring of ammonia in poultry forms.



POTENTIAL AREAS FOR PARTNERSHIP

DynAmmo is an electrochemical multi-electrode sensor that monitors ammonia continuously in diverse environments. The device provides fast and reliable measurement of ammonia that can be integrated into a variety of climate control units to regulate ammonia concentrations produced in commercial poultry houses and other industrial locations that produce dangerous amounts of ammonia.

INDUSTRY MARKET SECTORS

1. Poultry farms
2. Air Quality Monitors
3. Sensor Industries
4. Electronics circuit manufacturers

TRIAD is seeking a commercialization partner, such as air monitoring / AgTech systems integrators or industrial HVAC /commercial ventilation product companies, to present a commercialization plan for the DynAmmo gas sensor to potentially license the technology for an applicable market. The ideal partner should be able to provide engineering prototype design and testing, and outline a viable “Go-To-Market” sales and distribution plan.



SUMMARY

Ammonia is one of the most harmful gases present inside poultry houses that impacts health and growth of the chicken by inhibiting weight gain. Weight loss can be as high 17% causing up to \$2.5B in lost revenues annually for poultry farms. Active monitoring and real-time control of ammonia can increase profits for American farmers by billions of dollars a year by reducing the weight loss by just 2%. Today, there are few reliable sensors for actively measuring ammonia levels inside poultry houses. The DynAmmo multi-gas sensor developed at Los Alamos National Laboratory continuously monitors ammonia to provide poultry farmers complete control over the air quality in poultry houses to improve the weight gain of chicken and profit of the farmers.



WHY WE ARE BUILDING **DynAmmo Sensors**

The poultry industry produces 8.5B chickens annually with live chicken sales of over \$60B. Ammonia exposure reduces chicken weight gain between .5 – 1lb per growing cycle, amounting to \$2.5B of unrealized revenue. TRIAD's patented sensor technology reduces ammonia's impact on chicken production potentially increasing revenues. There are 200,000 poultry farms throughout the United States with the poultry sensor industry currently valued at \$375M. Draeger, a German company, entered the market in 2018 as the first solution provider. As regulation requirements increase each year for ammonia mitigation in the agricultural industries, the need for ammonia sensing and remediation is increasing.



WHAT'S BEHIND OUR **TECHNOLOGY**

This novel multi-gas electrochemical sensor is a solid-state device that detects ammonia in concentrations ranging from a few parts per million (ppm) to 1000 ppm. Combined with existing air ventilation systems, this innovative sensor design delivers poultry farmers complete control over a poultry house's climate conditions that result in chickens growing to their full weight within each growth cycle. These sensors have been successfully demonstrated in laboratory conditions to detect ammonia in numerous complex multi-gas environments.



OUR **COMPETITIVE ADVANTAGES**

- Low cost
- Low maintenance
- Integrates easily
- High sensitivity
- Higher efficiency
- Higher durability



OUR **TECHNOLOGY STATUS**

TRIAD's patented solid-state, multi-gas sensor design has been demonstrated successfully in a laboratory environment. We are now seeking commercial partners to help design a deployable industry-ready prototype for initial field testing in poultry farms. The prototype development and on-site field testing can be completed in one year with necessary engineering and commercial support.

PUBLICATIONS AND IP

S100634, U.S. Pat. No. 2004/0016104A1, "Electrodes for Solid State Sensors, U.S. Pat. No. US patent 6605202 "Electrodes for Solid State Gas Sensor" –and S102315, U. S. Pat. No. 7264700. "Thin Film Mixed Potential Sensors", S104887, U.S. Pat. No. 7575709, "Tape-cast Sensors and Method of Making".



KEY HIGHLIGHTS OF DynAmmo Gas Sensors

1. AN ALL SOLID-STATE SENSOR WITH NEGLIGIBLE MAINTENANCE

The DynAmmo gas sensor offers highly reliable measurements of ammonia under complex gas combination conditions and requires little maintenance. DynAmmo sensors are easy to integrate within the electronics of existing ventilation or climate control systems.

BENEFITS:

- ◎ **HIGHLY SCALABLE:** The fabrication of a DynAmmo gas sensor chip as envisioned would follow straightforward manufacturing procedures that are easy to scale and optimize for cost and performance requirements.
- ◎ **ACCURATE:** Due to its multi-electrode configuration, the DynAmmo gas sensor provides consistently accurate measurements and does not suffer from cross sensitivity that is a common challenge for electrochemical sensors.
- ◎ **RELIABLE:** The DynAmmo sensor has less than 2% error under complex gas environments that makes it highly reliable.

2. UNIQUE DESIGN WITH ENHANCED SIGNAL INTENSITY

The DynAmmo gas sensor's unique design allows the analyte gas to interact with the electrode only at the electrolyte-electrode interface achieving maximum signal intensity for a given gas concentration such as ammonia in this case.

BENEFITS:

- ◎ **NEGLIGIBLE DRIFT:** The novel sensor design removes the heterogeneous reaction between the analyte gas and electrode assuring sensor accuracy.
- ◎ **ROBUST PERFORMANCE:** The dense electrode design allows durable performance for significantly longer durations than traditional electrochemical sensors that use a porous electrode and dense electrolyte.



PREFERRED PARTNER ATTRIBUTES

- ⦿ Technology commercialization strategy (e.g., in-house development, partnering with industry leaders, sublicensing, etc.).
- ⦿ Established experience with electronics PCB manufacturing and channel development.
- ⦿ Expertise in one or more of the following: electronic circuit development and multichannel heat and resistor circuit fabrication.
- ⦿ Financial and personnel resources to be dedicated to this commercialization effort.
- ⦿ Demonstrated knowledge of product marketing and sales.
- ⦿ Proven technical and customer support model.
- ⦿ One or more U.S. executives with whom TRIAD personnel may interact
- ⦿ Ability and willingness to ensure compliance with U.S. Export Control law is a requirement



WHAT WE ARE REQUESTING

Please submit a [written response](#) on how your organization envisions utilizing and deploying this innovative technology in partnership with TRIAD. We look forward to reviewing your ideas on how we can together bring the DynAmmo gas sensors to the market. [Please respond by email to chris.meyers@lanl.gov](mailto:chris.meyers@lanl.gov), Subject Line: DynAMMO Commercial Call – Company Name by COB Tuesday, July 30, 2019.