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Nanoporous-Based Sensors for Electrical Detection of Degradation Products

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Aging of NW materials and environments

Advanced diagnostics for monitoring of degradation products in weapons systems have been called out as specific needs by the JASON Defense Advisory Panel, and internally at SNL. An embedded sensor would provide the Enhanced Surveillance program with a unique dataset with which to characterize materials degradation, potentially providing a way to *in-situ* diagnostics for weapons systems health monitoring.

We will present our work on the development of a novel, robust, compact (~1 cm^3) embedded sensor for direct electrical detection of materials degradation products in nuclear weapons systems. This is a new program that is based on successes for the development of direct electric readout sensors for fission gases, I_2 in particular. The device platform has low power requirements, exhibit stable and selective performance over a wide temperature range, and survive a variety of vibration conditions. The ability to selectively detect degradation products will introduce a new diagnostic capability to assess the health of nuclear weapons systems, providing confidence in the functional performance of the weapons system.

The sensor developed herein will serve as an integrating sensor, meaning it will record whether any degradation product was ever present during the sensor's lifetime. This is especially useful in cases where degradation products may subsequently react with other components, or gradually leak out of the system, and not be present upon disassembly during routine surveillance testing. This work will be divided into three main thrusts: (1) design of nanoporous getter materials, (2) electrical testing, and (3) materials integration. Nanoporous getter materials will be tailored to selectively absorb the target degradation products. Precision electrical testing will be performed in order to elucidate how the sorption of gas molecules influences the electrical properties of the nanoporous materials. Simple DC measurement techniques will be used in addition to identification of 1-3 individual frequencies that can be used to interrogate the device.

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