TECHBRIEF

SELECTIVE H_2 SENSING THROUGH USE OF PALLADIUM AND PLATINUM-BASED NANOPARTICLE FUNCTIONAL SENSOR LAYERS INTEGRATED WITH ENGINEERED FILTER LAYERS

OPPORTUNITY:

The invention is a method for sensing the H_2 concentration of a gaseous stream through evaluation of the optical signal of a hydrogen sensing material comprised of Pd- or Pt-based nanoparticles dispersed in a matrix material. The sensing layers can also include engineered filter layers as the matrix or as an additional layer to improve H_2 selectivity. This technology is available for licensing and/or further collaborative research from the U.S. Department of Energy's National Energy Technology Laboratory.

CHALLENGE:

The ability to selectively sense H_2 is critically important for a broad range of applications spanning energy, defense, aviation, and aerospace. One of the most significant needs is for sensors that are capable of leak detection of H_2 at levels up to the lower explosive limit. Additional applications of hydrogen sensors requiring operation at elevated temperatures include monitoring of hydrogen in metallurgical processes as well as monitoring the composition of fuel gas streams in power generation technologies such as gas turbines and solid oxide fuel cells. Measurements of H_2 levels dissolved in transformer oil can also enable condition-based monitoring to provide early detection of potential failures with large associated economic and environmental impacts.

OVERVIEW:

The invention is a method for H_2 sensing in a gas stream by utilizing the shifts in an optical signal generated by a hydrogen sensing material, where the hydrogen sensing material is comprised of Pd-based nanoparticles, Pt-based nanoparticles, or a combination thereof dispersed in an inert matrix. The hydrogen sensing material is in contact with the constituents of a gas stream, with one of the components being diatomic hydrogen (H_2), having a concentration which may vary over time. The optical signal is based on a comparison of incident light illuminating the hydrogen sensing material and exiting light which is transmitted, reflected, scattered or a combination thereof by the hydrogen sensing material.

ADVANTAGES:

Optical-based sensors are particularly well-suited for H_2 sensing due to a number of inherent advantages, including elimination of electrical wiring and contacts at the sensing location, which provides benefits in terms of safety and sensor longevity in potentially explosive atmospheres, harsh environments, and at high temperatures. The concept of applying top filter layers above a functional sensing layer to overcome cross-sensitivity is very appealing in the multicomponent gas mixtures of real applications.

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APPLICATIONS:

Applications of hydrogen sensors requiring operation at elevated temperatures include monitoring of hydrogen in metallurgical processes as well as monitoring the composition of fuel gas streams in power generation technologies such as gas turbines and solid oxide fuel cells. Measurements of H_2 levels dissolved in transformer oil can also enable condition-based monitoring to provide early detection of potential failures with large associated economic and environmental impacts. A broad range of sensor devices and technologies have been applied to hydrogen sensing including chemi-resistive, electrochemical, catalytic, work function, acoustic, and optical-based approaches.

PATENT STATUS:

U.S. Patent No: 10,345,279

Issued: 07/09/2019

Title: *Palladium and Platinum-based Nanoparticle Functional Sensor Layers and Integration with Engineered Filter Layers for Selective H_2 Sensing*

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NETL Reference No: 15N-01

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