Visually Detect Hydrogen with Reversible Color Changing Pigments

Reactive pigment compound that can be added to polymers, ceramics, and even paint or tape

Durable and highly sensitive, hydrogen specific, visual hydrogen detector for sensing a hydrogen leak or the presence of hydrogen in a confined environment from approximately 0.1% to approximately 100% by volume with the ability to operate in a wide range of temperatures, from -100°C to +500°C. This chemochromic pigment can be added to injection molded parts, textiles, tape, paint, caulk, and more.

Executive Summary
UCF research scientists have created a hydrogen detector that exhibits a noticeable color change in the presence of small quantities of hydrogen gas. The pigment includes hydrogen-sensitive compounds combined with nano-sized metal activator particles (catalysts) and is then preferably coated on a porous or woven substrate. This substrate could be a polymer, ceramic, or even paint or tape (see UCF ID# 30572). These compounds are highly specific to hydrogen and exhibit no interference from other gases such as carbon monoxide, methane, ethylene, and/or ammonia. In the presence of hydrogen, the composition rapidly changes its color from beige to black depending on the exposure time and hydrogen concentration in the medium. After hydrogen exposure ceases, the original color of the hydrogen sensitive pigment is restored, and the visual hydrogen detector can be used again. It has variable reversibility capability, which means the regeneration or bleaching time of the pigment can be easily altered from seconds to days with a simple change in composition.

Background
With the widespread use of hydrogen as an ecologically clean fuel and a possible replacement for fossil fuels, safety issues concerning the large scale handling of hydrogen are a high priority. The explosive nature of hydrogen, even at low concentrations, and the fact that it is odorless and colorless make hydrogen leaks especially dangerous. The use of odorants allows for easier detection, but would render the gas useless for high purity needs, such as fuel for the space program and for fuel cells. Conventional hydrogen detectors and sensors fall into one of five categories: catalytic combustion, electrochemical, semiconductor-based, thermal conductivity, and visual detectors. Current electronic, electrochemical or optical systems are complicated, bulky and expensive devices. Many visual hydrogen detectors are susceptible to environmental effects and may crack, peel or be washed off by rain. Other detectors are complicated to manufacture, and may only be applied to specific substrates such as glass. Detectors utilizing catalytic combustion are not specific to hydrogen and often produce false alarms in the presence of methane, ammonia, carbon monoxide, and/or propane. For the gas permeable matrix that encapsulates the hydrogen sensitive pigment see UCF ID# 30572

Application
The technology can be used to produce inexpensive, user-friendly visual hydrogen detectors for hydrogen leak detection, monitoring, identification and quantification. Sensor manufactures, hydrogen production facilities and hydrogen transporter could utilize this technology to meet their monitoring needs by use of this inexpensive and reusable product. This chemochromic pigment can be added to injection molded parts, textiles, tape, paint, caulk, and more.

Tech Fields
Hydrogen Fuels

Keywords
reversible, hydrogen gas, hydrogen detection, hydrogen leak, chemochromic pigments

U.S. Issued Patents
8,003,055 | 8,268,392

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