Hydrogen Safety Through Advanced Gas Chromic Coatings for Leak Detection in Next- Generation Storage and Transportation Infrastructure

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With the accelerated need for clean energy sources, hydrogen stands at the forefront of widespread adoption. Hydrogen leaks are difficult to detect due to the lack of odor, near invisible flame and smokeless combustion. Current technologies like electrochemical, palladium-based, and fiber optic sensors can detect hydrogen leaks in large infrastructures but lack spatial resolution, making it difficult to locate the exact leak source. The purpose of this project is to develop a gas chromic WO3/Pd nanoparticle paintable sensor to provide a simple and reliable approach to hydrogen detection. It works through a chemical reaction that triggers a color change in response to hydrogen exposure. Notably, this technology operates without requiring power, has a fast response time, and operates significantly efficient. The materials used in this work are non-hazardous. The structure consists of a paintable, stretchable WO3-Pd sensor preparing by photochemical deposition combined with acrylic polymer. This work includes conducting tests and experiments to gather data using gas stations, and close reactors for all response time, selectivity, gas exposure,and sensitivity. The outcome is the development of a functional paintable, quick reversible sensor within 10 minutes, The hydrogen detection paintable sensor maintains high performance that responds within 30 seconds and 91% sensitivity in 1% of hydrogen at room temperature. This innovative sensor holds significant potential for use in various hydrogen-related applications in storage and transportation. By leveraging gas chromic technology, in safety system for storage and transportation infrastructure, supporting the growth of the hydrogen economy as a sustainable solution for a cleaner future.

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