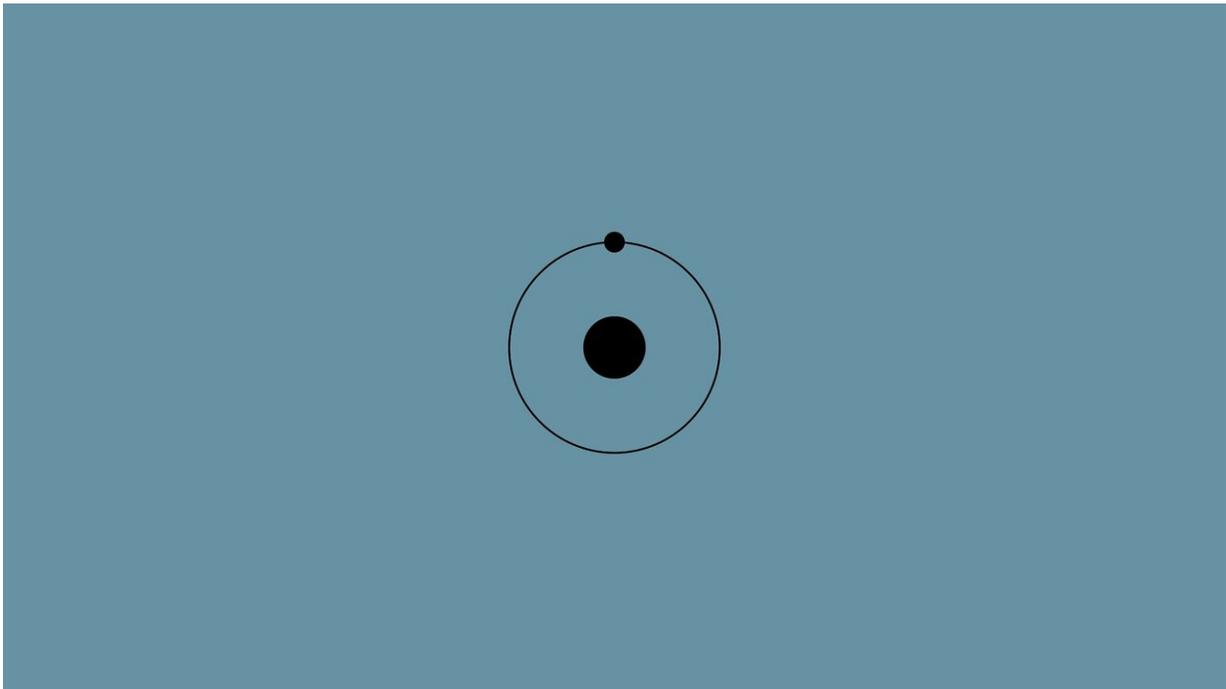


New optical hydrogen sensors eliminate risk of sparking

April 29 2021, by Alan Flurry



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Hydrogen as a clean, renewable alternative to fossil fuels is part of a sustainable-energy future, and very much already here. However, lingering concerns about flammability have limited widespread use of hydrogen as a power source for electric vehicles. Previous advances have minimized the risk, but new research from the University of Georgia now puts that risk in the rearview mirror.

Hydrogen vehicles can refuel much more quickly and go farther without refueling than today's [electric vehicles](#), which use battery power. But one of the final hurdles to hydrogen power is securing a safe method for detecting hydrogen leaks.

A new study published in *Nature Communications* documents an inexpensive, spark-free, optical-based [hydrogen sensor](#) that is more sensitive—and faster—than previous models.

"Right now, most commercial hydrogen sensors detect the change of an electronic signal in active materials upon interaction with hydrogen gas, which can potentially induce hydrogen gas ignition by electrical sparking," said Tho Nguyen, associate professor of physics in the Franklin College of Arts and Sciences, a co-principal investigator on the project. "Our spark-free optical-based hydrogen sensors detect the presence of hydrogen without electronics, making the process much safer."

Not just for cars

Hydrogen power has many more applications than powering electric vehicles, and flammability mitigating technologies are critical. Robust sensors for hydrogen leak detection and concentration control are important in all stages of the hydrogen-based economy, including production, distribution, storage and utilization in petroleum processing and production, fertilizer, metallurgical applications, electronics, environmental sciences, and in health and safety-related fields.

The three key problems associated with hydrogen sensors are [response time](#), sensitivity, and cost. Current mainstream technology for H₂ [optical sensors](#) requires an expensive monochromator to record a spectrum, followed by analyzing a spectral shift comparison.

"With our intensity-based optical nano sensors, we go from detection of hydrogen at around 100 parts-per-million to 2 parts-per-million, at a cost of a few dollars for a sensing chip," Tho said. "Our response time of .8 seconds is 20% faster than the best available optical device reported in the literature right now."

How it works

The new optical device relies on the nanofabrication of a nanosphere template covered with a Palladium Cobalt alloy layer. Any hydrogen present is quickly absorbed, then detected by an LED. A silicon detector records the intensity of the light transmitted.

"All metals tend to absorb hydrogen, but by finding the suitable elements with a right balance in the alloy and engineering the nanostructure to amplify subtle changes in light transmission after [hydrogen](#) absorption, we were able to set a new benchmark for how fast and sensitive these [sensors](#) can be," said George Larsen, a senior scientist at Savannah River National Laboratory and co-principal investigator on the project. "All while keeping the sensor platform as simple as possible."

More information: Hoang Mai Luong et al, Sub-second and ppm-level optical sensing of hydrogen using templated control of nano-hydride geometry and composition, *Nature Communications* (2021). [DOI: 10.1038/s41467-021-22697-w](https://doi.org/10.1038/s41467-021-22697-w)

Provided by University of Georgia

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