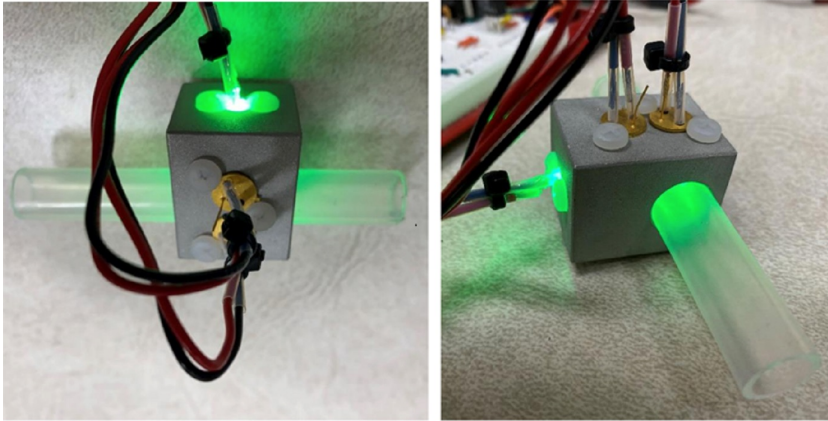


TECHNOLOGY SOLUTION

Sensors



Optical concentration sensor for liquid solution

Light scattering approach to precisely measuring solution concentrations

Innovators at the NASA Kennedy Space Center have developed a new optical sensor for measuring concentration in a liquid solution. The sensor was designed for measuring the pretreat solution concentration within the Universal Waste Management System (UWMS), a specialized toilet designed for the International Space Station (ISS) and other future missions. The sensor was developed to replace the current pretreat concentration sensor within the UWMS that uses electrical conductivity instead of light-based methods. Using established methodologies and commercial components, the new sensor can precisely measure the concentration or pretreat within the waste treatment solution using the light passed through and scattered by the solution. The optical sensor can be adapted to measure the concentration of solutions across various industries.

BENEFITS

- Straightforward to adopt: the optical sensor is built with commercial components and is based on established techniques, making commercialization simpler
- Less prone to voltage drift and contamination: the light-based method of this technology should outperform conductivity-based sensors in these regards
- Improved reliability: the use of a scattering cell samples light passing throughout the solution, ensuring reliability of readings
- Relatively compact: the sensor should be able to be miniaturized to roughly one cubic inch

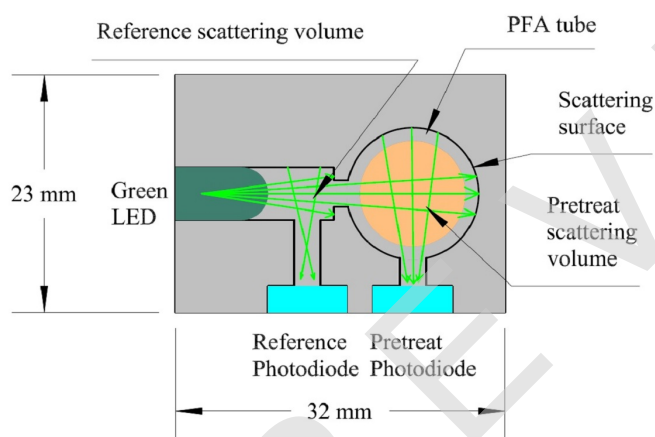


THE TECHNOLOGY

Typical concentration sensors, like the one initially used in the UWMS, rely on changes in electrical conductivity to measure the concentration of a solution. These measurements using conductivity are prone to voltage drift over time, leading to unreliable measurements as the sensor ages.

The optical sensor developed here uses light scattering to measure the solution concentration without the issue of voltage drift. In this sensor, light from a green LED is passed into the sensor housing where it hits a first detector (i.e., a photodiode) to establish a reference of the amount of light before scattering. Simultaneously, the light from the LED scatters through the pretreat solution and then hits a second photodiode to measure the amount of light after scattering. The difference between the amount of light measured by the two detectors is used to calculate the concentration of the pretreat solution (based upon Beer's Law). The optical concentration sensor has been demonstrated to effectively measure pretreat concentrations in both still and flowing liquid conditions and is resistant to contamination issues as necessitated by the UWMS.

The optical pretreat concentration sensor is at technology readiness level (TRL) 4 (component and/or breadboard validation in laboratory environment) and is available for patent licensing.



Schematic of the optical sensor for measuring pretreat concentration

APPLICATIONS

The technology has several potential applications:

- Aerospace: measuring solution concentrations in fluid management systems (e.g., waste management, fuel management)
- Industrial: measuring solution concentration in food and beverage processing, pharmaceuticals production, medical devices, etc.
- Wastewater processing: measuring solution concentration in terrestrial wastewater treatment across various scales (e.g., municipal wastewater treatment plant, decentralized chemical toilet)

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