WiSys Ref: T180036

Device to Monitor Airborne Silica for Enhanced Occupational Safety

Market and Background

Silicosis is an uncurable and sometimes lethal lung disease caused by inhalation of crystalline silica dust that can be present in occupational settings such as mining, construction, pottery, and masonry. To minimize exposure to hazardous airborne silica for workers in the US, the Occupational Safety and Health Administration (OSHA) enforces a personal exposure limit. OSHA recently cut the previous 8-hour average personal exposure limit (100 µg/m3 SiO_2) in half to a more stringent 50 µg/m3 SiO_2. In order to remain compliant with this limit, industries currently use a standard analysis technique that involves filter collection for 8 hours, creating a sample that is sent off-site for specialized laboratory testing with x-ray diffraction. With this technique, not only is the shipping and specialized methodology expensive, but it also takes days to weeks to receive readings, resulting in a substantial delay on the ability of industry employers to mitigate threats to their employees' health. In an alternative approach for faster readings, laser light scattering can be used to measure the dust in the air of a work environment. However, while silica particles would be detected by this strategy, it would also indiscriminately detect other less-hazardous particles in the air. False positives from detection of dust could cause unnecessary remediation and excess costs. Therefore, a technique that is faster, simpler, and silica-specific would be critical to economically enhancing the safety of the estimated 2 million US workers at risk for exposure to crystalline silica dust.

Research and Development Status

Researchers at the University of Wisconsin-Eau Claire have designed a new device to rapidly quantify breathable, airborne silica. This device uses a novel adaption of a technique previously used almost exclusively for water quality analysis. To achieve this, it collects ambient air and uses specialized components to purify the air and collect particles of interest into an aqueous solution. Silica particles in solution then undergo chemical processes to create an acid that is subsequently bound to a light-emitting (chemiluminescent) molecule that can be detected and measured by light-sensitive electronics. This chemiluminescence-based strategy is simpler and likely more sensitive than a potential alternative strategy of absorbance, which is more cumbersome because it requires multiple components to provide a light source, reference cell, and a light detector. The current design of this device can fit comfortably on a table top for portability, and employers can use it without specialized laboratory experience. Preliminary results suggest that this new device has a silica particle detection limit of less than 1 µg/m3, appropriate for use towards compliance with the new OSHA personal exposure limit of 50 µg/m3. In addition, preliminary work also indicates that the device can make measurements in as quickly as 15 minutes, making it a much faster complement to the current analysis standards that take days to weeks. Overall, this new airborne silica detection device is a compelling answer to the challenge of rapidly and cost-effectively detecting life-threatening contaminants in occupational air environments.

Critical chemistry has been optimized for specificity to airborne silica particles. A prototype of the device utilizing this chemistry is under development with funding through the Applied Research WiSys Technology Advancement Grant. WiSys is seeking strategic partners for field testing of this device, providing input for incorporating into workplace safety programs, as well as for development for mass manufacturing, followed by marketing, sales, and distribution.

Applications and Key Benefits

- Detects airborne silica particles to maintain compliance with new, stringent OSHA limits for industries including mining, construction, pottery, and masonry; Complements the standard x-ray diffraction-based technique
- Fast, real-time readings in minutes to support safety program
- Reduces cost of unnecessary remediation by minimizing false positives: Detection is specific to silica particles
- Simple to use with minimal training and no specialized laboratory expertise; Small and portable tabletop device

Intellectual Property

A U.S. Patent Application is pending for this technology. For more information, please contact our licensing team at licensing@wisys.org.