Optical Light Microscopy: A Novel Tool for Near Real Time Coal Mine Dust Monitoring

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ABSTRACT

Resurgence of respirable dust-related diseases among coal miners in several regions has underscored the need for enhanced dust monitoring methods. In particular, capabilities are needed that provide near real-time measurements—and that can do so for primary dust components of interest such as silica. To address this need, a new monitoring concept has been tested that uses optical microscopy with polarized light and an image processing routine to classify and size dust particles. Typical coal mine dust particles were deposited on a glass substrate and imaged under different lighting conditions using a polarizing light microscope. The image processing algorithm detected the particles in the images; then, their properties were analysed and used for classification. Here, results are presented on composite dust samples that include four primary dust constituents: coal, kaolinite, silica, and limestone. They indicate that coal and total mineral fractions can be easily estimated, and the mineral fraction can be subdivided into major constituent classes. Based on promising results, a monitoring device has been envisioned with the potential to count and classify coal mine dust particles and collect semi-continuous data that may provide insights about dust sources and develop control strategies to mitigate the exposure.