

# Optically Powered Gas Monitoring System Using Single-Mode Fibre for Underground Coal Mines

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## Research

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## Abstract

We present an optically powered, intrinsically safe gas monitoring system to measure four essential environmental gases (CH<sub>4</sub>, CO<sub>2</sub>, CO and O<sub>2</sub>), together with ambient temperature and pressure, for underground mines. The system is based on three key technologies developed at UNSW: (1) power-over-fibre (PoF) at 1,550 nm using a single industry-standard, low-cost single-mode fibre (SMF) for both power delivery and information transmission, (2) liquid-crystal-based optical transducers for optical telemetry, and (3) ultra-low power consumption design of all electronics. Together, this approach allows each gas monitoring station to operate with less than 150 mW of optical power, meeting the intrinsic safety requirements specified by the IEC60079-28 standard. A 2-month field trial at BMA's Broadmeadow underground mine proved the cabling compatibility to the mine's existing optical network and the stability of the system performance. Compared with conventional electrically powered gas sensors, this technology bypasses the usual roadblocks of underground gas monitoring where electrical power is either unsafe or unavailable. Furthermore, using one fibre for both power delivery and communication enables longer distance coverage, reduces optical cabling and increases multiplexing possibilities and data throughput for better awareness of underground environment.

## Full Text

This preprint is available for [download as a PDF](#).