

## Nanocrystalline ZnO based MEMS Gas Sensors with CMOS ASIC for Mining Applications

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### Abstract:

In this paper a nanocrystalline (nc) zinc oxide based hybrid gas sensor with signal conditioning ASIC has been reported for sensing and transmitting the information about methane concentration from the underground coalmine environment. A low power, low temperature nc zinc oxide MEMS based gas sensor has been designed, fabricated and tested for the purpose with a power consumption of  $\sim 70\text{mW}$  and sensitivity of 76.6 % at 1.0% methane concentration at a sensor operating temperature of  $150^{\circ}\text{C}$ . For transmitting the output of the gas sensor, a voltage controlled oscillator (VCO) chip integrated with a low noise amplifier has been fabricated in  $0.35\mu\text{m}$  CMOS technology to convert the voltage output of the gas sensor to desirable frequency. The power consumption of the chip has been obtained to be around  $3\text{mW}$ . The amplifier gain is set suitably  $\sim 13$  to apply the desirable control voltage ( $\sim 1.2\text{V}-3.2\text{V}$ ) to the VCO. The noise of the amplifier has been obtained to be around  $2\mu\text{V}/\text{Hz}^{1/2}$ . The output frequency of the VCO varies from  $20\text{kHz}$  to  $100\text{kHz}$  for the change in methane concentration from 0 to 1%. The output of the VCO chip can be applied as a modulating signal to a commercially available transceiver, which transmits the signal to the control room.