A Micromachined Planar Pellistor Using an Electrochemically Deposited Nanostructured Catalyst

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The use of calorimetric sensors for the detection of combustible gases is well known. However, state of the art devices (most of which employ Pt wire coils surrounded by refractory beads impregnated with catalyst) suffer from numerous drawbacks. These include comparatively high power consumption, labour intensive manufacturing processes and, at best, only moderate poison resistance. The use of alternative technologies to overcome these problems is therefore of considerable commercial interest.

The planar substrate used in this work comprises a platinum resistive heater encapsulated in silicon nitride, deposited on a silicon wafer. A lithographically patterned gold layer was deposited to form an electrode directly above the micro-heater. Anisotropic KOH back etching was used to create a thin suspended membrane in order to reduce thermal losses. The performance of the heater structure was compared with the predictions derived from thermal and stress simulations [1]. The simulation models were refined on the basis of experimental experience and subsequently used to further improve the substrate design.

The nanostructured catalyst was electro-chemically deposited onto the gold electrode using a novel liquid crystal templating approach [2]. This produces a highly uniform film with readily controlled pore properties. Moreover, the catalyst has high surface area, good mechanical and thermal resilience and demonstrates high activity towards combustible gases.

The combination of silicon microfabrication and electrochemical deposition of the nanostructrured catalyst allows a unique degree of control over the location of the catalyst on the device, the thickness of the catalyst layer, and the nanostructure of the catalyst material

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REFERENCES

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2. G. S. Attard, P. N. Bartlett, N. R. B. Coleman, J. M. Elliott, J. R. Owen, and J. H. Wang, *Science*, **278**, 838 (1997).

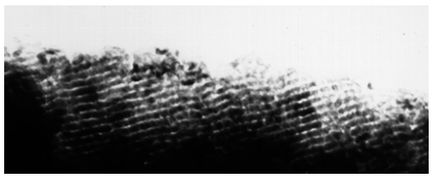

Figure 1. TEM of nanostructured Pd film deposited from a lyotropic liquid crystalline plating solution.

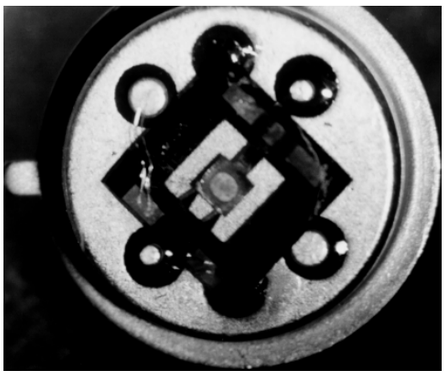

Figure 2. Picture of a micromachined planar pellistor. The active catalyst area in in the centre of the device supported on the thin silicon nitride membrane which contains the embedded Pt heater.

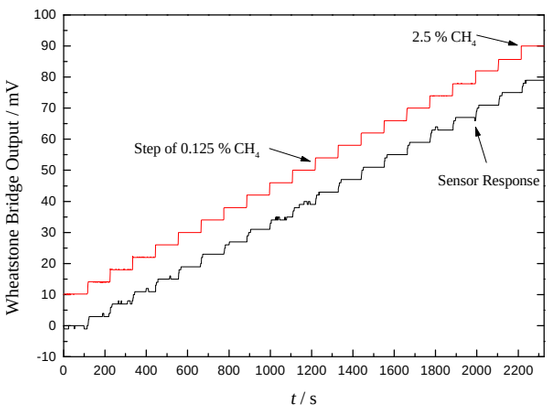

Figure 3. Sensor responses to 0.125% concentration steps of methane in air.