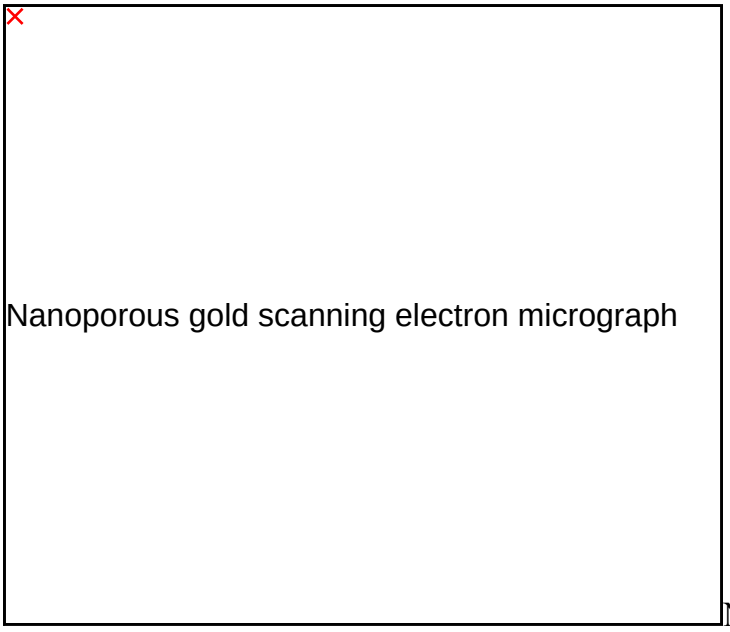
Nanoporous Materials

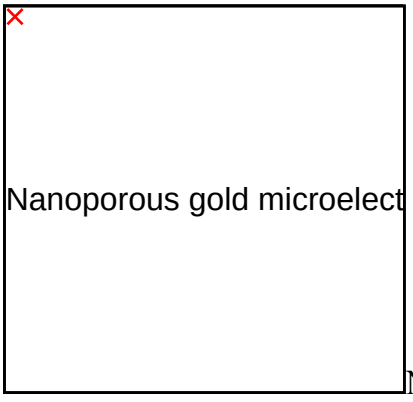
A highly active form of metal catalyst has been developed in recent years based on nanoporous metals which can be formed by additive or subtractive processes.

The 3D structure of NPG as a system of interconnecting nanopores in a skeleton of metal nanofilaments presents a number of unique characteristics;

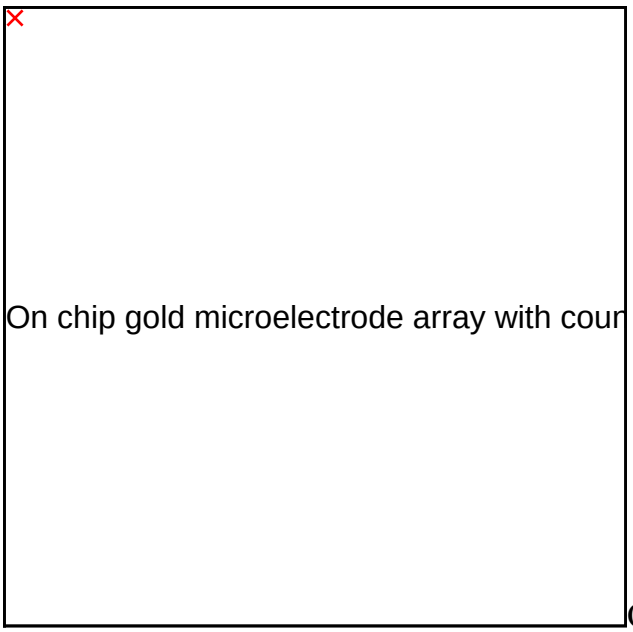
- High electronic conductivity as it is an interconnected structure
- The active catalyst filament can range from 5-50 nm
- The surface area is as high as 20 m2 g-1
- The porosity is >70 %
- It is mechanically far stronger than expected
- It remains active at low temperature (room temperature or below)
- It has a good thermal stability,
- It is resistant to oxidation
- It is biocompatible



Nanoporous gold scanning electron micrograph



Nanoporous gold microelectrode for sensing



On chip gold microelectrode array with counter and reference

The enhanced electrocatalytic properties of NPG have also investigated for a number of sensing applications by incorporation of the NPG onto microdisc arrays with integrated reference and counter electrodes as low cost alternatives to single standard microdisc electrodes. The arrays were fabricated at Tyndall using standard silicon microfabrication techniques of metal and dielectric materials deposition followed by patterning with photoresists and finally dicing into individual chips for packaging and electrochemical test.

The microelectrode array was then modified with NPG. The array was utilised for oxygen detection in water samples to analyse drinking water quality in rural India. The NPG modified microdisc array outperformed by more than two times the unmodified Au disc array in terms of signal to noise ratio and response time both of which help to facilitate remote sample analysis.

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Related Publications

- Porous alumina thin films on conductive substrates for templated 1-dimensional nanostructuring
  Solid State Ionics volume **216** pages **110 to 113** (2012)
  Authors: N. Holubowitch, L.C. Nagle, J.F. Rohan

- Nanoporous Gold Catalyst for Direct Ammonia Borane Fuel Cells
  Journal of The Electrochemical Society volume **158** issue **7** page **B772** (2011)
  Authors: Lorraine C. Nagle, James F. Rohan

- Nanoporous gold anode catalyst for direct borohydride fuel cell
  International Journal of Hydrogen Energy volume **36** issue **16** pages **10319 to 10326** (2011)
  Authors: Lorraine C. Nagle, James F. Rohan

- Characterisation of Nanoporous Gold for Use in a Dissolved Oxygen Sensing Application
  BioNanoScience volume **5** issue **1** pages **55 to 63** (2015)
  Authors: K. Twomey, L. C. Nagle, A. Said, F. Barry, V. I. Ogurtsov