NANOSOURCE IAPP-Marie Curie project

Participants:

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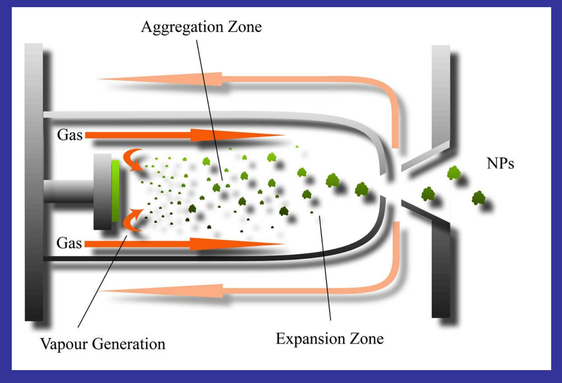
- **NCSR Demokritos, 15310 Aghia Paraskevi, Greece**
- **Mantisdeposition Ltd, Thame, Oxfordshire OX9 3BX, UK**

Goal of the project

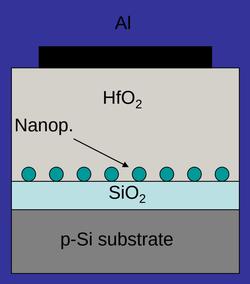
The goal of the NANOSOURCE project (2008-12) was to develop techniques for the deposition of metal and semiconducting nanoparticle materials. Specific areas of interest for applications include electronic and optoelectronic devices, sensor devices and self-assembly techniques .

Deposition method



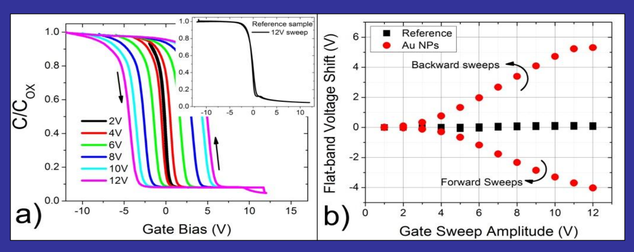
➢Figure illustrates the generation of nanoparticles, in which a magnetron attracts ionized argon gas, sputtering the platinum target material into the aggregation zone. The pressure (approximately 1 mbar) causes the sputtered material to aggregate to form particles that increase in size until they reach the expansion zone. The nanoparticles then entered a second chamber with lower pressure (3 x 10-3 mbar) where they were deposited onto the substrate. The argon gas flow rate and distance traveled through the aggregation zone can be adjusted to produce nanoparticles of a controllable size onto the substrate, although to ensure that the dynamics were consistent for each sample only the deposition duration was varied.

- **Nanoparticle memory devices (Pt, Au nps)**



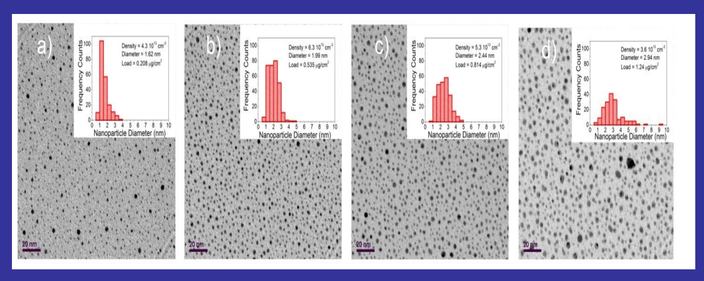
➢Test devices used to observe charge storage in gold nanoparticles

Electrical Results



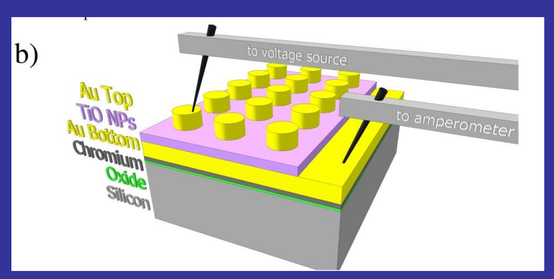
➢ C-V sweeps used to investigate the memory effect

TEM results

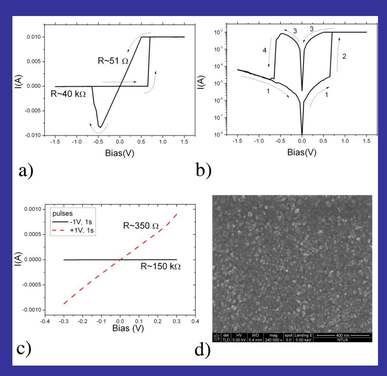


➢ TEM images showing ultra miniature nanoparticles. Their use has a pronounced memory effect !

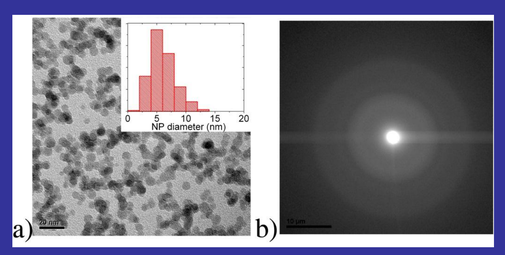
- **Memristive Devices (TiO_2 nps)**



➢ Two terminal Au/TiO2 nps/Au devices realized

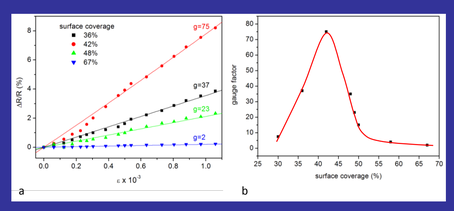


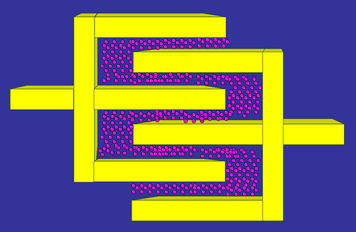
➢I-V characteristics showing the resistive memory behavior



➢ TEM images showing the amorphous TiO_2 nps used in the memristor

- **Nanoparticle Sensors (Strain and chemical sensors)**

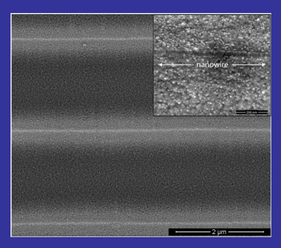




➢ On the left: Strain gauge measurements of a nanoparticle sensor showing and order of magnitude increase compared with continuous metal films.

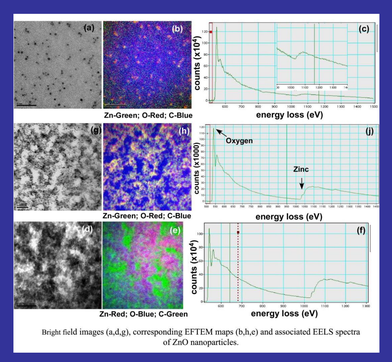
➢On the rigth: Device used with nps deposited between IDE

- **Self-assembled Nanoparticles**

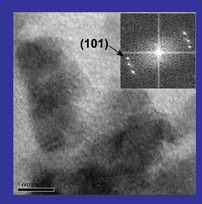


➢ Silver nanoparticles self-assembled into nanowires exhibit increased SERS signal of rhodamine

- **Material Studies: ZnO nps**



Bright field images (a,d,g), corresponding EFTEM maps (b,h,e) and associated EELS spectra of ZnO nanoparticles.



Publications:

‘High strain sensitivity controlled by surface density of Pt nanoparticles’ Nanotechnology 23 285501 (2012)

‘Raman enhancement of rhodamine absorbed on Ag nanoparticles self-assembled on nanowire-like arrays’, Nanoscale Research Letters 6:629 (2011)

‘Electrostatic self-assembly of nanoparticles into ordered nanowire arrays’ J. Materials Research 26 209 (2011)

‘Two dimensional nanoparticle self-assembly using plasma activated Ostwald ripening’, Nanotechnology 22 235306 (2011)

‘Optimization of hafnium oxide for use in nanoparticle memories’ Microelectronic Engineering, Volume 88, Issue 7, July 2011, Pages 1189-1193

‘ZnO nanoparticles produced by novel physical deposition process’ , Appl. Surface Sc., 257, 5366 (2011)

‘Assembly of charged nanoparticles using self-electrodynamic focusing’, Nanotechnology, 20, 36 365605 (2009)

Acknowledgments:

SEVENTH FRAMEWORK PROGRAMME

MARIE CURIE ACTIONS

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