# Towards new ammonia sensors based on individual metal oxide nanowires

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Solid state devices based on metal oxides are amongst the most popular types of gas sensors for monitoring toxic species, such as carbon monoxide (CO) and nitrogen oxides (NOx) [1]. In the last years, significant research efforts have been devoted to extend their fabrication to the nanoscale, due to the excellent sensing properties of nanowires, related to the high surface-to-volume ratio. In general, the exclusive properties of nanostructured materials in respect to bulk materials have attracted research efforts because of their potential applications in electronic devices [2].

The feasibility of having gas and optical sensors based on individual nanowires has been demonstrated, and the integration of nanowires in prototypes devices has been validated [3]. Nevertheless, the fabrication of electrical contacts with high stability, low contact resistances and ohmic behavior remains a challenge. Focused Ion Beam (FIB) lithography is a powerful fabrication technique for prototypes with dimensions in the range of the nanoscale [4]. Using this technique, electrical contacts are fabricated over the nanowire with electron beam assisted deposition while ion beam assisted deposition can be used to extent these contacts to large metal electrodes, giving macroscopic access to the electrical response of the nanowire while preserving the nanowire from ion damage. The resulting devices provide an excellent opportunity to study the electrical, optical and gas sensing properties of individual metal oxide nanowires.

In this work, we report the fabrication of individual metal oxide nanowire-based sensors using FIB lithography (see attached image) and their characterization as ammonia sensors. Ammonia (NH3) is normally considered a dangerous pollutant classified as “dangerous for the environment” by EU and US regulations. Their performances and the possibility of integrating them in autonomous systems powered by energy harvesters will be shown and discussed.

**References**

[1] B. Hoffheins, in: R.F. Taylor, J.S. Schultz (Eds.), Handbook of Chemical and Biological Sensors, IOP Publishing, Bristol, (1996) 371.
[2] Xing-Jiu Huang and Yang-Kyu Choi Sensors Actuators B, 122 (2007) 659.
[3] A. Kolmakov and M. Moskovits, Annu. Rev. Mater. Res, 34 (2004) 151.
[4] F. Hernandez-Ramirez, A. Tarancon, O. Casals, J. Rodriguez, A. Romano-Rodriguez, J. R. Morante, S. Barth, S. Mathur, T. Y. Choi, D. Poulikakos, V. Callegari and P. M. Nellen, Nanotechnology, 17 (2006) 5577.

**Figures**

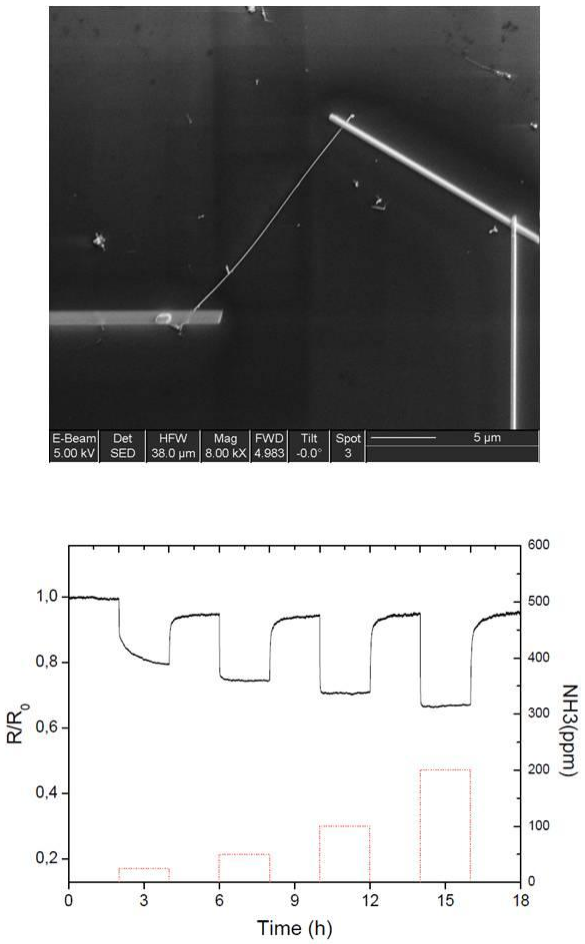


*Fig.1. (a) SEM image of a SnO2 nanowire electrically contacted with FIB nanolithography techniques. (b) Response of a SnO2 nanowire towards different ammonia concentrations. Reproducible, reversible and stable responses are observed.*