Title

Porous organic frameworks containing platinum nanoparticles for silicon nanowire based chemical sensing

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Abstract

Porous organic frameworks (POFs) have been discovered recently, and are promising new materials for molecular separations, chemical sensing and catalysis. In this study we show the successful development of a chemical sensor, which is based on the covalent immobilisation of melamine-terephthaldehyde POFs on amino propyl modified silicon nanowires (SiNW). These nanowires were made by top down photo-lithography and act as a (nano-sized) field effect transistor (FET). Changes in the chemical composition of the immobilised POF (the selector layer) is directly monitored by the FET (the transducer) as a change of source-drain current or as a change of gate potential.

The POFs on top of the SiNW was post-synthesis functionalised by uniformly distributed platinum nanoparticles (PtNP) through impregnation using chloroplatinic acid, followed by in situ sodium boron hydride reduction. The obtained PtNP@POF-SiNW chemical sensor showed enhanced sensitivity for methanol vapor detection.

Reference:

Anping Cao, Meixia Shan, Laura Paltrinieri, Wiel Evers, Liangyong Chu, Lukasz, Poltorak, Johan H. Klootwijk, Beatriz Seoane, Jorge Gascon, Ernst J. R. Sudhölter, and Louis C. P. M. de Smet, Enhanced vapor sensing using silicon nanowire devices coated with Pt nanoparticle functionalized porous organic frameworks, Nanoscale 10, 6884 (2018).

Figure

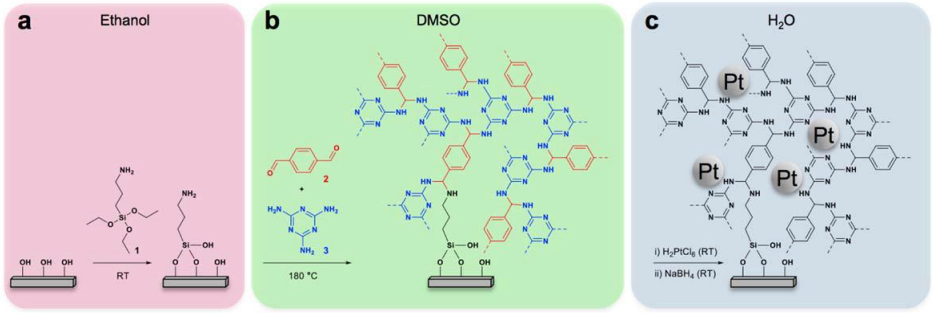

Figure 1: (a) Amino propyl modification of silicon nanowires via their surface silanol groups; (b) *in situ* formation of melamine-terephthaldehyde porous organic frameworks; and (c) post-synthesis modification with platinum nanoparticles

Curriculum Vitae of Ernst Jan Robert Sudhölter

Ernst Sudhölter studied chemistry with specializations in Organic chemistry and Physical chemistry at the University of Groningen (1971-1977). He obtained his MSc degree with distinction.

In the period 1977-1981 he did his PhD research at the University of Groningen with Prof. Dr. Jan B.F.N. Engberts on a physical-organic subject entitled: ”Aggregation of single- and double-chained methylpyridinium iodide amphiphiles. Micelles, Reversed-Micelles, Vesicles, and Liquid-Crystals”. The PhD degree was obtained with distinction (‘cum laude’).

In the period 1981-1984 he was as a research chemist employed at the Royal/Dutch Shell Laboratory in Amsterdam. Firstly, at the fundamental department of ‘Physical and Inorganic Chemistry’, and secondly, at the applied department of ‘Hydrocarbon Processing’.

Between 1984-1990 he was assistant professor (UD) and subsequently associate professor (UHD) employed at the University of Twente, Department of Chemical Technology, Laboratory of Organic Chemistry with Prof. Dr. Ir. David N. Reinhoudt.

In the period 1990-2006 he was appointed as professor of ‘Physical-organic chemistry’, and since 2000 as a professor of ‘Organic chemistry’ at Wageningen University in the Netherlands.

In the period 2007-2014 he was appointed as chairman of the department of Chemical Engineering (ChemE), Faculty of Applied Sciences (TNW) of Delft University of Technology, and as professor of Organic Materials & Interfaces (OMI) at the same department. Since april 2014 he is full-time professor of Organic Materials & Interfaces (OMI). As leader of the section OMI, the research is focussed on surface (bio) functionalization of semiconductor surfaces for the development of chemical and biosensors, on the functionalisation of different membranes for selective separations of ions and organic molecules and for solar fuel devices, and on organic photo-voltaic dye molecules. The research is always multidisciplinary and combines chemistry, physics, biology and electrical engineering.