

CMOS Compatible Electrostatically Formed Silicon Nanowire as an Ultrasensitive and Selective Gas Sensing Platform

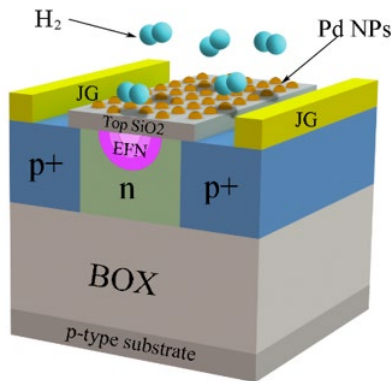
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Abstract

Electrostatically Formed Nanowire (EFN) sensor is a CMOS based multi-gate silicon nanowire (NW) field effect transistor (FET) where the nanowire is formed electrostatically post fabrication. Unlike conventional silicon nanowires, the formation of the NW-like conducting channel in EFN does not involve any lithography and etching processes. Instead, it relies on the electrostatic control of the conduction channel below the top oxide by appropriate biasing of three gates: bottom gate and two lateral junction gates. Reverse biasing of the p^+/n junctions electrostatically shape a wire of several nm in diameter (pink semi-circle in Figure 1). Target gas molecules, adsorbed on the top SiO_2 surface, modulates the current conduction through the nanowire via field-effect.



Surface functionalization of these EFN sensors by metal nanoparticles is an effective approach to increase sensitivity and achieve selectivity towards various gases. In addition, by employing a specially designed large area sensing antenna improves the EFN sensor response by several orders of magnitudes. We demonstrate a world record response of $\sim 90\%$ to 30 ppb H_2 which can be further improved by several orders of magnitude with increasing antenna size; this may pave the way to a VLSI-based gas sensing platform with Ppt-level gas sensing capabilities.

Short Biography



Yossi Rosenwaks is a chair Professor of Nanoelectronics, former Dean of Engineering. Professor of Electrical Engineering at TAU since 2005 and currently a member of Israel higher council of education (CHE), and a managing director of Fraunhofer Innovation Platform (FIP) for sensors. Prof. Rosenwaks current research interests include nanowire transistors and sensors, two-dimensional materials and devices, and charge carrier dynamics and transport in semiconductors. Prof. Rosenwaks is a co-author of more than 200 peer reviewed articles, 10 international patents, has presented 80 invited talks at international meetings, and has supervised more than 70 PhD and MSc students, 8 of which are currently faculty at top research universities. He served as the president of the Israel Vacuum Society (2003-2006), and as the director of TAU's Wolfson Center for Applied Materials Research and Gordon Center for Energy Studies (2005-2008), and the head of the Physical Electronics department (2011-14), and the Dean of the Faculty of Engineering (2014-2022).