

Fabrication and Characterization of N-MOSFET-based Cantilever Sensors for Molecular Detection

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MOSFET (metal oxide semiconductor field effect transistor)-based cantilevers offer an improved performance of cantilever-based sensor due to their sensitivity to local stress at the channel surface and their better noise properties. The basic principle of MOSFET-based cantilever detection is based on the change of surface stress due to molecular adsorption, resulting strain in the MOSFET channel and change of a drain current.

In this work, two types of N-MOSFET were designed on the top of identical cantilevers ($400 \times 95 \mu\text{m}$), i.e., U-shaped channel (width/length ratio of $10 \mu\text{m}/5 \mu\text{m}$) with parallel direction to the cantilever (MEC 1) and single channel (width/length ratio of $50 \mu\text{m}/5 \mu\text{m}$) with non-parallel direction to the cantilever (MEC 2). The N-MOSFET-based cantilevers were fabricated on a 500 nm SOI wafer by combining CMOS standard process and bulk micromachining process whereas a drain current-drain voltage (I_D - V_D) characteristic of the MOSFETs was measured using semiconductor characterization system integrated with a probe station to make direct contacts to Al pads on the wafer. A micrograph of the N-MOSFET-based cantilever devices is shown in Fig. 1.

The deflection of the N-MOSFET-based cantilever was observed by ethanol vapor exposure. As a result, the drain current of both MOSFET types decreased, indicating the cantilever deflection when exposed by ethanol. The higher drain current change was reached by MEC 2 (Fig. 2) which indicated the higher sensitivity for MEC 2.

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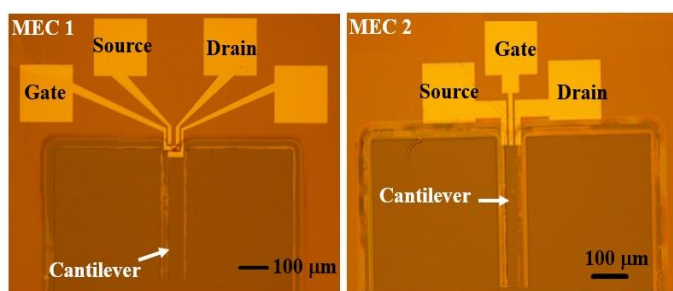


Fig. 1. A micrograph of N-MOSFET-based cantilever devices. MEC 1 and MEC 2 indicate U-shaped and single channel type of MOSFET, respectively.

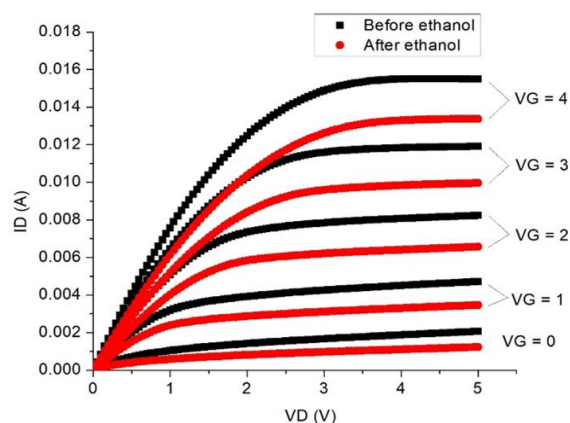


Fig. 2. I_D - V_D characteristic of the MEC 2 before (black line) and after (red line) ethanol exposure.