Optical investigation of Polymer-Functionalization of TiN-Nanohole-Arrays for Integrated Biosensor Applications

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Refractive index (RI) sensing based on plasmonic excitations is of large interest for applications in biosensing. State of the art plasmonic biosensors typically require external instruments such as spectrometers for readout, which limits the possibility of miniaturization. Fully miniaturized on-chip biosensors, however, have the potential to be used in applications ranging from agricultural monitoring to point-of-care healthcare solutions. Here, we discuss our progress on the fabrication and functionalization of plasmonic Titanium Nitride (TiN) nanohole arrays (NHA) on silicon substrates [1]. Such TiN-NHAs can be combined with Germanium photodetectors, for applications in integrated on-chip biosensors, in which the sensor output is directly available as electrical signals [2]. Our samples are fabricated in an 8" processing line at the IHP – Leibniz Institute for High Performance Microelectronics (Fig. 1 a) [3]. In particular, this requires the use of complementary metal-oxide-semiconductor (CMOS) materials for fabrication on the cost-effective silicon platform, which precludes the utilization of commonly used noble metals such as Au. Here, we focus on the use of the CMOS compatible TiN as a plasmonic material [1]. We present our device concept as well as experimental results for TiN surface functionalization. To that end, we use different types of polymers [4] as receptor layers for the detection of volatile organic compounds (VOCs) and a humidity measurement experiment to determine the qualitative binding on the polymer surface (Fig. 2). Our approach can lead to the application as a sensor for recognition of various specific molecules and analytes of interest in an on-chip setup (Fig. 1 b).

References

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Figures

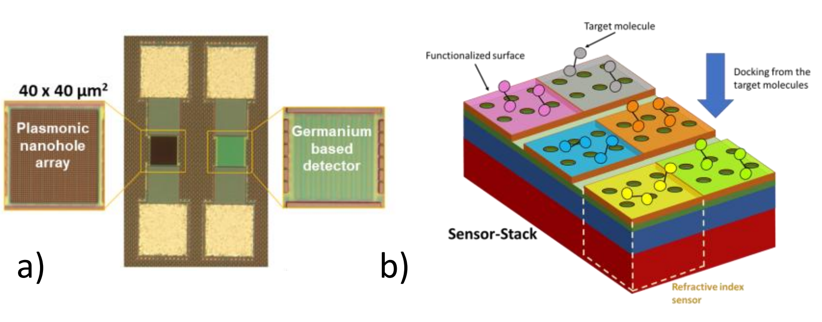

Figure 1: In a) the single integrated Sensor, with and without the 2D plasmonic TiN-Nanohole-Array. In b) a concept for a 6-segment surface functionalized bio sensor, "electronic nose".

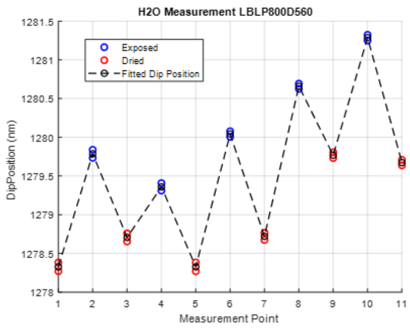

Figure 2: Humidity measurement with PAA/PAH on the TiN-Nanohole-Array