“Novel concepts for CO2 detection by differential resonant nanosensing”

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Due to the excellent capabilities of detecting mass loading in the range of hundreds of zeptograms, the nano-scale resonant sensors are envisaged for the detection of the ultra small gas concentrations, in agreement with the exigent standards for the air quality monitoring. It is the purpose of our presentation to show novel concepts for CO2 detection by means of resonant differential principles applied to silicon nano-electromechanical systems (NEMS), where a vibrating functionalized nano-beam is changing its resonance frequency as a function of adsorbed CO2 gas coming from the ambient (1-3). Such future resonant nanosensors for CO2 detections will be built by means of CMOS-SOI silicon technology, where hundreds of thousands of NEMS devices can be performed on the same wafer, and where sensor and electronics may be on the same chip, as an ultimate target. The novelty of our approach comes from the original chemical functionalization of the silicon surface and by the use of the reference sensing monolayer, which will have the same physical properties like the sensing layer, but no sensing capabilities. Such an *all-differential* sensing principle where a reference layer is added on the surface is solving the prior-art drift issues specific to differential resonant chemical sensors, where the reference loop had only an uncoated surface, which could not eliminate the humidity and aging effects of sensing layer from the sensor response. The chemical design of the sensing monolayer with main focus on the functional sensing group was based on Bronsted –Lowry theory. The proposed sensing layers contain CO2 sensitive terminal groups such as 1,8 diazabicyclo[5,4,0] undec-7-ene (DBU) or 1,5 diaza [3,4,0]-non-5-ene (DBN) The reference layer for the DBN and DBU based sensing layer are obtained by the reaction of DBN and DBU moieties with HCl in order to inactivate the DBU and DBN moieties which are CO2 sensitive. This is performed by selective direct printing of liquid HCl only on the reference beam as a terminal step of the functionalization process performed for the CO2 sensing layer.

References

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