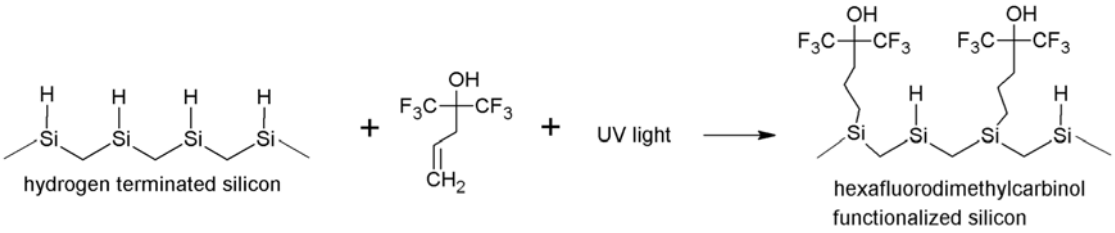
Spatially Patterned Chemistry on Nanomechanical Resonators for Targeted Sensing

Nanomechanical resonators, with their extremely small mass and high surface/volume ratio, are very sensitive to added mass and are well suited for vapor sensing applications. The Naval Research Laboratory's research in this regard has made the first integrated nanomechanical resonators in CMOS. Integrated arrays of such resonators is a requisite so that high performance vapor sensing to be practically realized. However, attaining enhanced and selective adsorption of targeted vapors on nanomechanical resonators has been elusive. A traditional approach of spin cast polymer films present the problem of being many times thicker than the nanomechanical resonator, essentially burying the resonator in the adsorptive polymer and completely damping the resonator. To address this problem, we developed a generic, lithographically patterned, monolayer functionalization scheme based on a UV-mediated reaction between terminal alkenes and a hydrogen terminated surface. As one example, we have accomplished the selective surface functionalization of a vapor adsorptive monolayer of hexafluorodimethylcarbinol on nanomechanical resonators. Hexafluorodimethylcarbinol is known to be an effective sorbent polymer for dinitrotoluene (DNT), commonly found in the headspace over trinitrotoluene (TNT). The ability to functionalize only the resonator and not the surroundings is of great importance for attaining the highest sensitivity. It opens the possibility of patterning different functional groups with different types of chemistry for targeted adsorption of different molecules on separate resonators within a nanomechanical resonator array.



J.W. Baldwin, M.K. Zalalutdinov, B.B. Pate, M.J. Martin, and B.H. Houston, in NANO '08: 8th IEEE Conference on Nanotechnology, 2008, IEEE: Austin. p. 139-142.

Patents or other steps toward commercialization: Patent application submitted: "Patterned functionalization of silicon and/or diamond nanomechanical resonators for chemical sensing," J.W. Baldwin, M.K. Zalalutdinov, B.B. Pate, B.H. Houston, Navy case # 99430
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