MULTIVALENT, MULTIFUNCTIONALIZED, AND MULTICHIRAL GLYCOSIDE RECEPTORS IN CHIRAL GAS SENSING

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Volatile organic compounds (VOCs) exhaled, excreted, and released through the skin reflect underlying physiological activity and pathological states. However, this valuable information remains mostly inaccessible due to the inherent challenges associated with sensing of VOCs: 1) detection of sub-ppm concentrations of weakly interacting small molecules that lack prominent or universal functional groups and 2) discrimination between structurally similar molecules and enantiomer pairs while maintaining sensitivity toward diverse families of biorelevant VOCs. Despite the growing demand for biosensors that could enable rapid and non-invasive breath and body odor analyses, there is a shortage of bioactive recognition layers with high sensitivity, selectivity, and capability for chiral discrimination.
Glycans are natural multichiral and multivalent interaction mediators that can be incorporated into functional sensing layers [1]. Exploitation of the innumerous possible combinations of glycan scaffolds and site-specific modifications opens a route toward versatile sensing applications. Selectively substituted monosaccharides (sMS) modified with aryl or benzyl esters, ethers, and carbonates are commonly used as glycosyl donors for the synthesis of complex glycans. The combination of a chiral multivalent monosaccharide scaffold with diversely functionalized substitutions can facilitate discrimination of weakly interacting, structurally similar or enantiomeric VOCs through the formation of a unique docking site. A meticulous rational design of the identity and arrangement of substituents can enable the functionalization of nanomaterial surfaces and the tuning of selectivity toward VOCs.
In this work we demonstrate enantioselective gas sensing using devices based on semiconducting single-walled carbon nanotubes (sc-SWCNTs) functionalized with substituted thioglycoside receptors as interaction mediators [2]. This represents the first instance of glycans that function in an ensemble with single sc-SWCNTs for chiral discrimination in the gas phase. This novel strategy prompts the exploration of the endless combinations of chiral scaffolds and modification patterns with various VOCs, and empowers future sensing applications.

References:

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