OPEN SEMINAR

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Title: Role of Surface Modification and Surface Free Energy Components in Attachment of Sensing Molecules on Strip based Sensors

Date: 20th October 2017

Time: 10:00 AM

Place: L8

Abstract: Strip based sensing systems are a subject of interest for their low costand versatility. A strip based sensor generally consists of a platform, alinker-spacer and a sensing element (such as a fluorophore or a biomolecule). Effective detection of the analyte requires theimmobilization of the highest possible density of the properly oriented sensing molecules on the platform surface. Several factors such as surface morphology, surface roughness, density of preceding stacks, surface free energy, surface acidity-basicity contribute to achieving a properly oriented immobilization of sensing elements. For an optical sensor, the sensing element is a dye whose spectra changes upon interaction with an analyte. Immobilizing the dye can also change its spectral property and the changes need to be determined before using it as the sensing element. The surface acidity-basicity of the platform prior to attachment of the dye influences the nature of attachment, relative amounts of monomer and aggregates, and shift in optical signatures of the dye. While the effect of Bronsted acidity and basicity is well covered in literature the effect of Lewis-acid/base components have not been well studied and were investigated. With different surfaces with the same linker, it was observed that the Lewis acid-base components of the surface energy rather than the total surface energy affect the nature of attachment of the dyes and thus the spectra. Thus tuning the spectra of a dye by using surfaces with different surface energy components enables use of the dye for different applications. As an application, dye attached on PET substrate showed promise as optical pH sensor in the range of pH 7-10. Next, the effect of the linkers on attachment of dye molecules was studied keeping the surface unchanged. The DFT and TDDFT studies when combined with the experimental results showed that aggregate formation on the surface predominated over the covalent bond formation for each linker used. And by using analogous dyes, the spectra could be tuned. These outcomes of these studies enabled the choise of the optimal platform-linker combination for strip based detection of Fe(III) and Cr(VI). The attached dye molecules showed specificity in detecting the said metal ions even in presence of other ions. These learnings from the dye based optical sensing platforms were utilized in strip based immunosensing platforms. The influence of surface morphology and surface energy components on the antibody attachment on the surface was also studied. It was observed the Lewis acid component as well as the total surface energy played a major role in determining the density and orientation of attached antibodies.