DEVELOPMENT AND CHARACTERIZATION OF A PHOTOSTABLE BORON-DIPYRROMETHENE DYE AS A VERSATILE PROBE FOR THE ANALYSIS OF SURFACE FUNCTIONAL GROUPS

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Abstract
Developing reliable biosensors and microarray assays requires a precise knowledge of the functionalized surface because it determines the success of further reactions such as for instance the covalent attachment of biomolecules like DNA, proteins or antibodies.[1] Here, the density, accessibility and reactivity of functional groups are critical factors in systematically controlling the formation of a subsequent sensor layer on the support. In addition, the selectivity of a sensor often depends on the quality of the selective layer that comprises the recognition element. Chemical labeling techniques have been widely employed to identify and quantify surface functional groups.[2] In general, chemical labeling involves covalent attachment of molecular probes to functional groups and their assessment with sensitive spatially resolving measurement techniques. Since the labeling process should ideally be fast, quantitative and specific for a certain type of functional group, reactive fluorescent dyes in conjunction with spatially resolving fluorescence detection systems are often employed, especially for fast mapping of larger areas. Alternatively, UV/vis-absorption or electron spin resonance (ESR) spectroscopies are frequently used. One of the challenges with these techniques, however, is to translate the relative signal from the surface measured by the instrument into an absolute number of surface functional groups. For the purpose of traceable (to the SI system) quantification, complementary characterization techniques like X-ray photoelectron spectroscopy (XPS) or time-of-flight secondary ion mass spectrometry (ToF-SIMS) harbor a tremendous potential.[3] To show the efficient use of XPS and fluorescence as complimentary tools—fluorescence being a fast scanning and non-destructive, relative measurement technique and XPS being a slower and more-localized yet traceable method—we developed a photostable and reactive boron-dipyrromethene (BODIPY) -based fluorophore with a high number of fluorine atoms which specifically reacts with amines and employed it for the quantification of amino group density on SiO2 supports, one of the most common reactive silica supports. We report here on issues of specificity, cross-talk, reaction yield and optimal derivatization for standard amino microarrays slides.

Keywords: amino surface; amino group density; XPS; Fluorescence; BODIPY; label

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