Nanomaterial-based supports for ultra-thin layer chromatography and ellipsometry

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Abstract

Discovery of new drugs can improve healthcare worldwide, but this process of discovery and target validation can take between three and six years. Understanding and quickly screening drug-protein interactions is crucial to shortening the target validation period. Our long-term goal is to apply a novel detection technique to efficiently screen drug interactions with immobilized proteins on nanomaterial supports. Ultra-thin layer chromatography (UTLC) is an improved separation technique based on planar chromatography. Our novel detection technique combines UTLC stationary phases composed of highly oriented 3-D nanostructures with transmission birefringence imaging and ellipsometric measurements. UTLC stationary phases are prepared using two nanofabrication techniques. Glancing angle deposition (GLAD) fabricates sculptured thin film (STF) microstructures on transparent glass substrates. These are coated with aluminum oxide (Al_2O_3) via atomic layer deposition (ALD) to enhance and tune the chemical properties of the stationary phase for higher resolution and better separation of analytes. These techniques fabricate STF's with increased available surface area for interactions between the stationary phase and the analyte in separations, thus improving detection sensitivity. The possible advantages of using GLAD-UTLC plates include decreased separation times, enhanced resolution, lower consumption of mobile and stationary phases, and lower levels of detection for the analytes. The hypothesis in this study is that microfluidic devices can be created for use with GLAD-UTLC plates and an imaging instrument to detect low concentrations of a lipophilic dye. We will test birefringence changes using ellipsometry to understand the interactions of the dyes with the nanostructures, and to generate intensity plots which translate into calibration curves to determine limit, resolution, and efficiency. The outcome of this work will be the creation of a sensitive analytical technique for rapid and efficient separation of analytes, and can be applied to high-throughput screening of solute-protein interactions for clinical applications.