Fabrication of dense, uniform aminosilane monolayers: A platform for protein or ligand immobilization

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HIGHLIGHTS
- Study aimed at designing surfaces to achieve uniform and high biomolecule binding.
- We correlated silanization reaction parameters with protein binding efficiency.
- Achieved uniform and dense silane monolayer as biomolecule immobilization template.
- Human IgG was covalently immobilized on prepared silanized surfaces.
- We reported silanization reaction parameters that yielded maximum protein binding.

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ABSTRACT
Designing biointerfaces with enhanced biomolecule binding abilities, along with their distribution and presentation on the surface, largely requires control over underlying surface chemistries. In an effort to correlate experimental parameters to surface properties, ligand distribution and biomolecule binding, the influence of (3-aminopropyl)triethoxysilane (APTES) concentration (1, 2 and 4 vol%) and duration of the silanization reaction (5–60 min) on the number of available —NH2 groups were determined and correlated with the amount of surface bound human immunoglobulin G (HlgG). Surfaces silanized with 2 vol% APTES for 30 min yielded a densely populated silane monolayer (1.0–1.2 nm) where the average molecular orientation was 38 ± 2° with respect to the surface normal. A surface density of —NH2 moieties of ~1019/cm2 was obtained and was significantly higher compared to other conditions evaluated. The combined data from ellipsometry and atomic force microscopy (AFM) analyses supports our findings. Coupling of HlgG to surfaces silanized with 2 vol% APTES for 30 min yielded ~1013 lgG/cm2, which was significantly higher than values obtained at 1 vol% APTES for 30 min. The distribution of immobilized HlgG was noted to be dense and uniform on surfaces silanized with 2 vol% APTES when visualized using Nanogold® antibody conjugates. This study highlights the critical role of the experimental parameters that impact the biomolecule immobilization process on functionalized surfaces.

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1. Introduction
Sensing platforms that utilize functionalized surfaces have aided the study of complex biological reactions [1–4]. The design and fabrication of functionalized surfaces for the selective adsorption of