Temperature Programmed Desorption of benzene and aniline from functionalized silica surfaces.

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Biopolymer layer silicates are shown excellent adsorption capacity in textile dye contaminate wastewater treatment. Mainly the functional groups on the composite surface are responsible for the adsorption process. Since the biopolymers are not able to withstand high temperatures it is difficult to perform TPD experiments using the biopolymers. Usually, the textile dyes also have high vapour pressure; thus, it is challenging to transfer typical dye molecules to the gas phase employed in UHV chambers without decomposition. In this study, functionalized silica surfaces were used to mimic the biopolymer layer silicate composite. Anile and benzine was used to mimic the functional groups on the textile dye molecule.

Biopolymers used in studies in liquid phase were alginate and chitosan which contained -COOH and -NH_2 functional groups. For simulating typical surfaces, we used silica wafers, which were cut into 1 cm×1 cm squares (compatible size for UHV chamber sample holders). Thereafter silica surface was cleaned with acetone by sonication for 2 min. The cleaning procedure was repeated for 2 times. Cleaned silica surfaces were heated in a plasma oven for 15 min. Thereafter 2 mL of (3-aminopropyl)dimethylmethoxysilane and (3-Cyanopropyl)dimethylmethoxysilane were added with the TEOS surfactant to the surface. The reaction mixture was heated to 70 °C for 24 h. Thereafter functionalised silica surfaces were washed with acetone and stored in acetone solutions for further use. The silica surface functionalised with ─C≡N group was heated with 50% sulfuric acid for 1h to convert ─C≡N to ─COOH. Thereafter, functionalised silica surface was thoroughly cleaned with acetone and stored in acetone for further use.

The TPD experiments were carried out with a home build UHV chamber and provide information about typical binding energies. From these we deduce information about the binding process of dye molecule at adsorbents in real applications.