Abstract

Modification of inorganic surfaces with organosilane self-assembled molecules (SAM) is very interesting research field due to a wide range of applicability. By modification we change both, chemical and physical surface properties and consequently functionality of whole material. The most commonly used SAM molecules for modification of silicon surfaces are aminosilanes. The amount of coatings and the morphology of aminosilane layers depend on many parameters. For the preparation of homogenous and reproducible coatings it is essential to understand surface chemistry, molecular interactions and modification parameters.

Single crystal silicon wafers were modified with different silanes (aminoalkylsilanes: APTMS, APDMS, APEMS, APTES; aminoarylsilane APhS; aminoalkylsilane derivatives: UPS, EDA, DMS and alkylsilane ODS). Chemical composition and morphology of the modified surfaces were determined using surface sensitive characterization techniques XPS, AFM, SEM, ToF-SIMS and MTR-IR. I proved that the amount of silane coatings and the degree of polymerization strongly depend on many parameters. The effects of surface pretreatment, silane structure and concentration, presence of moisture, time and temperature of deposition were studied. Results show that the reactivity of aminosilanes with the Si-oxide surface and the polymerization of aminosilanes depend on the number of possible bonding sites of aminosilane molecule. Further I studied the influence of solvent on the modification process. I discovered that the amount of coating and consequently the morphology of modified surface can be easily controlled with the use of the appropriate solvent. The structure of silane layers is also strongly related to the structure of reactive organic part in the silane molecule. Further the stability of aminosilane layers was studied. Our results show that aminosilane layers are stable in air for the period of several months. Obtained results show that it is necessary to control precisely all the modification parameters to obtain smooth and uniform aminosilane coverage, otherwise uncontrolled silanization leads to the formation of thick and rough aminosilane layers, which may significantly influence on the application of modified surfaces.

The aim of the study was also to demonstrate the applicability of aminosilane modified silicon surfaces. From the obtained results we determined optimal silanization conditions and modified silicon capacitive microsensors with a purpose of using them for vapor trace detection of explosive gases. We demonstrated that the sensors modified with various silanes respond differently to the presence of TNT vapor.

Keywords: *silicon, self-assembled molecule, aminosilanes, surface analysis, detection of TNT*