DESCRIPTION FOR THE GENERAL PUBLIC

Well-defined materials such as metals, ceramics and plastics are no more capable of meeting the requirements set by new directions of applications. The current technological advances and the trend to manufacture materials with newer and newer properties bring about a great demand for products of such a type. The designing of innovative materials with strictly defined structure and properties is based on basic research because it is not possible to produce a desired material without prior studies of the problem on the molecular level and getting to know accompanying phenomena. In many cases a modification of particular material surface makes it possible to impart particular properties to the material. For many application directions, surface properties play a significant role because they decide wetting of the surface with different liquids, deposition of different substances, ability to separate immiscible liquids. In everyday life there is a great demand for such materials which are, for instance, hydrophobic and oleophobic (materials not catching dirt or undergoing self-cleaning), but also hydrophobic and oleophilic (materials enabling easy separation of oil/water mixtures), as well as many other materials which do not fog, are antistatic or anti-reflective. All the above properties can be created by a suitable modification of the initial material surface. Such surface modifying agents can be organofunctional silicon compounds that are an example of a hybrid material combining functions of organic (a particular functional group) and inorganic compound (silicon-oxygen skeleton). This hybrid character causes that these modifying agents have a great compatibility with most of materials and also results in the resistance and durability which are characteristic of silicon derivatives.

The subject of this project is the determination of the effect of organosilicon compound structure as well as kind and quantity of functional groups present in the compound on the surface properties of coatings and materials produced. In our research we are going to use two basic types of silicon compounds, namely organofunctional silanes and polysiloxanes. Most of functionalized silicon compounds are obtained in the process of hydrosilylation, i.e. the addition of hydrogen silanes to multiple bonds. Our research group specializes in synthesis of silicon compounds based on the process of hydrosilylation and we are fully convinced as to its high versatility and effectiveness. Albeit in some cases, particularly those when the derivatives containing hydroxyl, carboxyl or amino groups (i.e. groups that are characterized by hydrophilicity and polarity) take part in the reaction of hydrosilylation, problems appear with selectivity, poisoning of catalyst or even proceeding mainly competitive (undesirable) reactions. For this reason the subject of our research will be synthesis of organosilicon compounds using an alternative method, namely the addition of thio derivatives to multiple bonds. Contrary to hydrosilylation processes, no expensive catalysts based on transition metals (mainly rhodium and platinum) are applied, which results in economical, ecological and health benefits (the product does not contain heavy metals). A common feature of all these derivatives will be the presence of analogous functional groups in their composition due to which the effectiveness of their action can be compared. The choice of the functional groups will be aimed at obtaining materials with diversified properties. All the above compounds will be employed for the modification of surfaces by using a regular impregnation in solutions and the deposition by the sol-gel technique. The produced materials (coatings) will be subjected to measurements of wetting with different liquids.

Moreover, the project includes research on the character and way of bonding between silicon compounds and the surface as well as morphology of the surface after its modification with these compounds. Another element of the research will be obtaining functionalized silicas (from the silicon compounds produced within this project) using sol-gel process and the determination of the effect of the way of conducting the sol-gel process and drying the produced gel on the structure of the silica material obtained. Both in-situ produced coatings and silicas prepared by the sol-gel process will serve for increasing surface roughness and obtaining particular surface properties. Undoubtedly, such products can be counted among innovative and highly advanced materials with a great application potential.