ABSTRACT

This doctoral thesis entitled "Fabrication and investigations of physicochemical properties of hydrophobic and functional coatings and surfaces by means, among others, plasma modification technique" was prepared in the Department of Interfacial Phenomena at the Faculty of Chemistry of Maria Curie–Skłodowska University in Lublin supervised by Konrad Terpiłowski, PhD, DSc, Assoc. Prof. The research carried out as part of the thesis focuses on the study of the physicochemical properties of polysiloxane-based coatings obtained on the glass substrates by the sol–gel method and the dip–coating technique as well as the effect of low-temperature plasma modification of the substrate on the surface properties of the obtained coating. Moreover, the superhydrophobic effect on the polyoxymethylene surface was obtained using only the plasma modification technique, without any coating application.

In the theoretical part of the doctoral thesis the current state of knowledge in the field covered in the experimental part is concisely presented: the issues of surface wettability and surface free energy are discussed, the influence of surface topography on the surface properties as well as the problems related to the coatings hydrophobization are presented, and the subject of polysiloxane ones along with their preparation by the sol–gel method in combination with the dip–coating technique, and the use of plasma technology to modify the solids surface properties are considered.

At the beginning of the experimental part, the reagents and materials used in the research are presented. Moreover, the research methods are described in the way enabling the analysis reproduction. The research was divided into five stages. First, the effect of hydrophobization with hexamethyldisilazane of the plasma–activated glass substrates without the polysiloxane coating was examined. Then, the hydrophobization effect of the polysiloxane coating on the plasma–activated glass substrates was investigated using two different methods. In the third stage, the hydrophobized polysiloxane coatings with the filler in the form of modified silicas were studied. Subsequently, the coatings doped with the modified carbon nanotubes were obtained and characterized. The last stage consisted in a successful attempt to

obtain the superhydrophobic polyoxymethylene surface only as a result of low– temperature plasma modification, without the need for its coating or additional hydrophobization.

The research results allowed for the selection of optimal parameters for the synthesis of pure and filled polysiloxane coatings enabling hydrophobic and superhydrophobic surfaces obtaining. The factors for the effective hydrophobization of coatings with hexamethyldisilazane were analysed and indicated. The effect of the substrate modification with the low–temperature plasma obtained from various gases on the surface properties of the applied coatings was investigated. The physicochemical and functional properties of the obtained coatings were characterized. The superhydrophobic surfaces with self–cleaning properties were also produced using only the plasma modification technique, achieving a permanent effect over the time. The obtained coatings can be a good base for the construction of hybrid surfaces. The carried out research is of significant cognitive and potential application.