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Multifunctional polyhedral oligomeric silsesquioxanes as metal, textile and polymeric resin binder modifiers. PhD thesis.

**Polifunkcionalizirani poliedrični silseskvioksani
kot modifikatorji površin kovin, tekstila in
polimernih veziv**

DOKTORSKA DISERTACIJA

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Abstract

A new hydrothermal procedure for synthesis of polyhedral oligomeric silsesquioxanes (POSS) was developed. By this procedure, various homoleptic and heteroleptic POSS molecules can be prepared in a simple single step with basic hydrolysis. IR and ^{29}Si -NMR spectroscopic studies combined with mass spectrometric measurements were employed to confirm the molecular structure. POSS molecules with known structure of inorganic core and variously functionalized organic chains were used for the modification of metal, cotton fabrics and polymeric binder surfaces. Alkoxy functionalized POSS molecules were used as a corrosion inhibition thin film for the aluminium alloy Dural AA 2024. An ordered coating can be prepared using letter molecules by Sol-gel techniques. After hydrolysis, alkoxy groups, in addition to forming a three-dimensional network enabled the possibility of covalent interactions with the hydroxylated surface of the alloy, which also increases coating stability. The structure and morphology of the coatings were studied with the help of IR reflection-absorption (IR-RA) spectroscopic measurements combined with XPS measurements. The degree of corrosion inhibition was assessed with a salt spray chamber and potentiodynamic measurements, and showed good corrosion inhibition and around 10 times smaller current densities for the a 40 nm thick coating. POSS molecules bearing aminopropyl groups were used in combination with two cross-linkers, i.e., diisocyanatohexyl (DICH) and Tubiguard fix (TUB) for achieving a superhydrophobic and oleophobic effect. Contact angles, washing fastness and air permeability were optimized by modifying the application procedure and use of different POSS molecules. Amino and isooctyle bearing POSS molecules, in combination with DICH and TUB, exhibited a superhydrophobic effect on cotton fabrics. Self-Assembled Monolayers (SAM) of mercaptopropyl functionalized POSS molecules were prepared on gold and copper substrates. The order of SAM was studied by means of IR-RA spectroscopy combined with XPS measurements. The concentration of defects and pinholes were estimated with the use of redox couples. Analyses showed tidy SAM on the surface of gold and passivation against redox couples. Multifunctional POSS molecules bearing perfluoro groups on the corners were used as an additive for achieving self-cleaning properties of TISS paint coatings. Pigments used for the letter coatings were dispersed by incompletely condensed $\text{IB}_7\text{T}_7(\text{OH})_3$ POSS molecules.

Keywords: POSS, anticorrosion, thin films, SAM, cellulose, water and oil repellent, TISS coatings, self-cleaning.