

Abstract

Application of plasma techniques in rubber technology

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The aim of the thesis was an application of plasma techniques in rubber technology, focusing on activation and modification of fillers' surface. Continuing progress in material technology leads to increase in demand of elastomer materials of outstanding functional characteristic. Application of classic fillers (such as carbon black and silica) seems to be insufficient. For this reason modification of classic fillers and modern nanofillers is used more and more often in rubber technology. Unfortunately, application of nanofillers makes their dispersion in elastomer matrix worse, what can be eliminated by modification of their surface. Popular chemical treatments very often require chemicals, among others solvents, what additionally adversely affect the environment. Because of that, application of "clean" plasma techniques seems to be very interesting. There is possibility to have a chemically clean modification, which leads to modified material with better interaction with rubber matrix.

Thesis is composed of the following main chapters / tasks:

- activation of filler surface;
- modification of fillers surface with organic compounds;
- influence of modifications on properties of rubber vulcanizates;
- adaptation of original plasma reactor *Diener Zepto* to modification of powdered fillers.

Carbon fillers (such as multi-walled carbon nanotubes, graphene nanoplatelets), mineral fillers (such as silica, wollastonite, kaolin) and products of recycling (such as ground tire rubber) were studied in the frame of work.

The following analytical techniques were applied:

- tensiometric analysis of the surface free energy of fillers and its components;
- analysis of fillers surface with scanning electron microscope (SEM), equipped with X-ray diffraction microanalysis (EDX);
- analysis of fillers surface with time of flight secondary ion mass spectrometry (ToF-SIMS);
- mechanical and micromechanical properties of composites filled with modified fillers;
- analysis of crosslink density of composites filled with modified fillers;
- analysis of filler dispersion in rubber vulcanizates with a *Disper Tester* apparatus.

The results performed confirm on that applying RF plasma techniques creates a lot of possibilities to modify the surface of classic as well as modern nanofillers. Mechanical tests of sulphur vulcanizates point on reinforcement of rubber containing the modified fillers.

Keywords: elastomer materials, fillers, surface, plasm-chemical modification

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