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Synthesis of new organoelement copolymers based on polydimethylsiloxanes and aminophosphonates

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ABSTRACT

Based on commercially available 3-Aminopropyl (diethoxy)methylsilane new alkoxysilane with functional aminophosphonate group - diethyl (2-((3-(diethoxy (methyl)silyl)propyl)amino)propan-2-yl) phosphonate were synthesized and characterized. Obtained functional alkoxysilane were transformed to tetrasiloxane in active medium in the presence of acetic acid and then copolymerized with octamethylcyclotetrasiloxane (D4). The chemical structure of the resulting polymer was studied and confirmed by a combination of physical methods, namely, ^{1}H, ^{13}C, ^{31}P and ^{29}Si NMR, GPC, and IR spectroscopy. The thermophysical and rheological properties of the polymer were also studied.

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1. Introduction

The interest in the synthesis and study of the properties of compounds based on phosphorus compounds has grown considerably in the past decade [1]. Among these, a particular place belongs to 1-aminophosphonates that found use not only in agriculture but also in medicine [2]. These compounds also became popular owing to the Kabachnik-Fields reaction that occurs without side products and allows one to obtain a required compound in a quantitative yield [3].

Synthesis of polymeric structures is a matter of current interest since it expands our capability to create new materials, devices, formulations, etc. Incorporation of a new element into the structure of a polymer may offer a new set of properties due to the specifics of the respective element. For the moment, siloxanes, specifically polydimethylsiloxane (PDMS), are among the most popular polymers. Items and materials based on PDMS are used by consumers in almost every large industrial sector [4].

However, the literature currently offers only a few publications on the synthesis of hybrid organic-inorganic materials containing a 1-aminophosphonate moiety within PDMS [5,6]. It has been shown in studies by Jiang S. and Chao P. that incorporation of a 1-aminophosphonate organic substituent into a polymer matrix containing a siloxane moiety favours the emergence of the self-extinguishing properties in the polymer. Thus, incorporation of a functional aminophosphonate moiety into the structure of a pure polydimethylsiloxane frame is an interesting task since it allows one to expect that new materials with practically useful properties would be obtained. Apart from the self-extinguishing effect, one can expect that viscosity would change and hence new elastomeric materials may be obtained.

It should be noted that two synthetic methods were used in the published studies to obtain self-extinguishing materials: the sol-gel method and the hydrosilylation reaction. The co-oligomerization with octamethylcyclotetrasiloxane (D4) is also an important method for incorporation of a functional moiety into PDMS. However, the method for synthesizing polydimethylsiloxanes with an aminophosphonate moiety by polymerization with opening of a siloxane ring was not reported to date.

In this publication we suggest a new synthetic approach for the preparation of a polydimethylsiloxane with statistically distributed 1-aminophosphonate moiety along the polymer chain, using the

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