ANNOTATION

Yulia Bilichenko

"Synthesis of functionalized oligoaryloxyphosphazenes and polymers based on them"

Simple, more advanced, and scalable methods for synthesizing new oligophosphazenes with various functional groups have been developed. Their composition has been established, identifying more than 50 previously unreported compounds. The potential use of these oligomers for producing heat-resistant and non-flammable polymer composite materials has been demonstrated. Cyclophosphazene oligomers containing identical or different functional groups in the aryl oxy radicals linked to phosphorus atoms have been synthesized and characterized. These functional groups include hydroxyl, carboxyether, carboxyl, epoxy, and allyl groups. The composition and structure of these oligomers have been established, as well as their potential as modifiers for organic polymers and components for binders in fire-resistant or non-flammable polymer composite materials with enhanced thermal stability. Through the interaction of hexachlorocyclotriphosphazene (HCP) with other reagents, hexa-(2-methoxy-4-allylphenoxy)-cyclotriphosphazene has been obtained and isolated in crystalline form for the first time. X-ray structural analysis revealed an atypical distortion of planarity in the trimeric cycle. By epoxidizing the allylic bonds of hexa-(2-methoxy-4-allylphenoxy)-cyclotriphosphazene with peracids, an oligoepoxide has been produced, containing up to 70% of hexa-(2-methoxy-4-glycidylphenoxy)cyclotriphosphazene and more than 30% of a dimeric epoxide, whose molecules are constructed from two pentaepoxidic cyclotriphosphazene fragments connected by an unsaturated organic radical. Optimal conditions for the interaction of chlorocyclophosphazenes or their partially substituted derivatives with diphenylolpropane and resorcinol have been established, leading to the synthesis of polyhydroxyaryloxycyclophosphazenes with a maximum degree of chlorine substitution and the absence of gel formation. The reaction of hydroxyaryloxycyclotriphosphazenes with epichlorohydrin has led to the synthesis of a series of phosphazene-containing epoxy oligomers (PEO) containing ≥ 5 wt.% phosphorus, capable of curing with conventional or phosphazene-containing hardeners to form fire-resistant or fully non-flammable compositions. Based on rheological studies and combined thermal analysis data, optimal curing conditions for PEO with various hardeners have been established, along with possibilities for their processing using existing methods. A phenomenon of changing the exothermic effect to an endothermic one during the curing of PEO with carboxyl-containing phosphazene oligomers has been observed. The use of PEO for modifying epoxy resins or as binder components allows for increased fire resistance of the resulting polymer composite materials while maintaining or enhancing their physicochemical and mechanical properties. Methacrylate-containing oligophosphazenes have successfully passed tests as modifiers for dental filling materials, improving their main characteristics by 1.5 to 2 times, and are recommended for practical use.