Dielectric Properties of Silicone Compositions Containing Metallosiloxanes

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Dielectric elastomers are currently receiving increasing attention due to their potential use in robotics, in particular, for the artificial muscles creation., Silicone elastomers are one of the most preferred as matrix energy converters among these polymers due to a number of properties they have, such as good reproducibility of working cycles, a slight tendency to the Mullins effect and aging, the possibility of working in a wide temperature range, and low toxicity. The main disadvantage of silicones in this aspect is their low dielectric constant, which determines the use of high voltage to energy converter activation and, as a result, does not use the full potential of the silicones mechanical properties (tensile strength). It can be identified the approaches proposed to improve the dielectric constant of silicone transducer layer-energy: chemical modification of silicones with groups having a high dipole moment; introduction of conductive or high-dielectric polymer fillers; introduction of silica or metal oxide particles, obtaining elastomeric interpenetrating networks. Despite the abundance of research in this area, the problem of creating a dielectric electroactive polymer has still not found its solution, that's why research in this area relevant today.

In our study, we obtain silicone material with elastic properties by curing of low molecular weight commercially available polydimethylsiloxanes with organoalkoxymethalosiloxanes through polycondensation processes (Fig. 1). The approach developed allows us not only uniformly introducing a different amount of metal oxide component into the composition, but also varying the type of metal.[1] Iron, aluminum, and zirconium siloxanes were used for research.

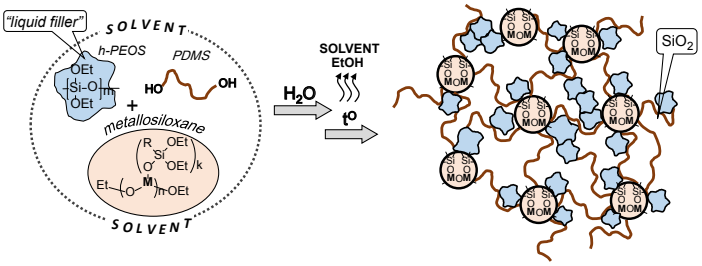

Fig. 1. Scheme of the composition formation.

It is shown that changing the initial ratio of the components can affect the mechanical properties of the final composition. In addition, it is possible to achieve higher values of dielectric constant in comparison with pure polydimethylsiloxane. We believe that this approach is convenient and promising for the production of silicon elastomers with sufficient dielectric properties to create actuators for artificial muscles.

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[1] Tebeneva N.A., Meshkov I.B., Tarasenkov A.N., Polshchikova N.V., Kalinina A.A., Buzin M.I., Serenko O.A., Zubavichus Y.V., Katsoulis D.E., Muzafarov A.M. *J. Organomet. Chem.* 2018, **868**, 112-121.