HIGH-VOLTAGE INSULATORS BASED ON POLY(2-OXAZOLINE)S FROM RENEWABLE RESOURCES

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The solvent-free reaction of ethanol amine with carboxylic acids is a common strategy for the synthesis of 2-oxazolines. Correspondingly, 2-nonyl-2-oxazoline can be synthesized from decanoic acid (derived from coconut oil), and 2-dec-9′-enyl-2-oxazoline from undec-10-enoic acid (derived from castor oil) [1]. Such 2-oxazoline monomers can be polymerized in microwave reactors in cationic ring-opening fashion using ionic liquids as reaction media, from which the polymers can be recovered by precipitation upon cooling and filtration [2]. Correspondingly, the ionic liquid can be 'recycled' for future syntheses. Homo- and copolymers like poly(2-nonyl-2-oxazoline)-*stat*-poly(2-dec-9′-enyl-2-oxazoline) and poly(2-dec-9′-enyl-2-oxazoline) can be crosslinked with multifunctional mercapto compounds in thiol-ene click reactions, which can be started by the application of UV light to a photoinitiator (present in the formulation) at room temperature. After curing, the polymer networks are insoluble in organic solvents (gel fraction = 100%). The permittivity of the crosslinked poly(2-oxazoline)s increases with the temperature and decreases with the network density. The changes of the loss factor, which quantifies a material's capability to store/transport charges, can be explained by interfacial polarization within the material. In summary, the values for the parameters like permittivity, loss factor and conductivity of crosslinked copoly(2-oxazoline)s are in the same range as for polyamides [3], and, hence, copoly(2-oxazoline)-based networks constitute 'green' alternatives for polyamides as electrical insulators.

[1] H.-J. Krause and P. Neumann (Henkel Kommanditgesellschaft auf Aktien), Eur. Pat. 0315 856 B1, 1995.

[2] C. Petit, K.P. Luef, M. Edler, T. Griesser, J.M. Kremsner, A. Stadler, B. Grassl, S. Reynaud and F. Wiesbrock, ChemSusChem 2015, 8, 3401-3404.

[3] M. Fimberger, I.-A. Tsekmes, R. Kochetov, J.J. Smit and F. Wiesbrock, Polymers 2016, 8, 006:01-006:12.