PROPERTIES OF CHITOSAN SOLUTION FLOW IN SHEAR AND ELECTRIC FIELDS

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The study is focused on influence of shear and electric fields on rheological and fiber-forming properties of chitosan solutions used in electrospinning of nanofibers and non-woven nanofbrous materials.

Chitosan of molecular weight of ~200,000 and degree of deacetylation ~80 mol.% (ZAO «Bioprogress») and glacial acetic acid were used. Rheological properties of solutions with chitosan concentration in range of 2.0-7.0 % by weight with 0.5-10% of added modifiers in 2-96% acetic acid were studied.

It was shown that viscosity rheograms of solutions with added modifiers are similar to the typical curves for dependences of viscosity of semistiff chain polymer solutions on shear strain with plastic flow or areas of maximum Newtonian and structural viscosity. Activation energy of viscous flow is 22-32 kJ/mol. Viscosity and degree of structurization decrease with time during the storage of fiber-forming solutions in static conditions for 2-10 days. However, there is no significant change of electric conductivity which is the critical parameter for electrospinning.

Optimal polymer, modifier and acetic acid concentrations in fiber-forming solutions for electrospinning of submicron fibers, nanofibers and nonwoven materials with specific properties were obtained. Corellation between concentration range for spinning of uniform defect-free fibers, average fiber diameter and diameter distribution was found.

Mathematical modeling of thin unstable conductive polymer jet in electric field with fiber deposition on different types of collecting electrode was performed. Random perturbations causing the bending of initial rectilinear jet and formation of expanding loop were used. Influence of type of collecting electrode on jet motion, deposition and fiber diameter was investigated.

Samples of chitosan-based non-woven nanofibrous material with chaotic and oriented fibers distribution were produced. Mechanical properties including surface density, strength and strain deformation in different directions measured. Influence of fiber orientation on mechanical properties of nanofibrous materials was studied.

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