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COMPOSITION COMPRISING A SYNTHETIC LINEAR POLYMER, ORGANIC SOLVENT, AND AN INORGANIC SALT

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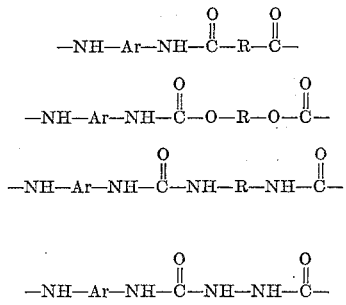
The present invention relates to a novel and useful composition of matter and to an improved process for forming such a composition. More particularly, it relates to an improved polymer solution and to an improved method for forming a polymer solution.

Many polymers are now known which have a combination of physical and chemical properties which make them well suited for the formation of various shaped articles such as filaments, yarns, films, tubes, and the like. One disadvantage of many of these polymers, however, is the fact that they have limited solubility in the usual solvents which makes it difficult to economically produce these shaped articles by the conventional casting procedures or extrusion processes such as wet- or dry-spinning. A solvent which would dissolve substantial portions of these polymers would obviously be highly desirable since it would materially reduce the amount of solvent required by these conventional processes.

It is an object of the present invention, therefore, to provide an improved composition of matter. Another object is the preparation of a polymer solution in which the polymer concentration is substantially increased. A further object is to provide a spinning solution which contains a high concentration of polymer. A still further object is to provide a process for the formation of an improved polymer solution. Other objects will appear hereinafter.

These objects are accomplished by the present invention which provides a liquid composition of matter comprising a solution of a polymer, a solvent, and a salt; the said polymer being selected from the group consisting of a polyamide, a polyurethane, a polyurea, and a polyureylene, having a solubility at 20° C. of at least 0.5% by weight in the said solvent and being of such structure that a major proportion of the recurring units in the polymer contain an arylene nucleus directly connected to two nitrogen atoms in the chain; the said solvent being a member selected from the group consisting of dimethylformamide, dimethylacetamide, N-methyl-2-pyrrolidone, dimethylsulfoxide; and the said salt being so chosen that it is sufficiently soluble in the said solvent and liberates an ion of a halogen atom having an atomic number of from 16 to 36 (i.e., the chloride and bromide anion) to such an extent that a solution of $\frac{1}{100}$ of an equivalent of tthe salt in one liter of the said solvent has a specific resistance of less than about 5000 ohm-centimeters at 20° C. By "a major proportion" is meant that the polymer chain is composed of at least about 50% of the defined structural units. The term "direcly connected" is used to signify that each such nitrogen atom in the chain is bonded to a nuclear atom. The term "specific resistance" denotes the resistance in ohms of 1 cubic centimeter of the material (salt/solvent solution) at a particular temperature (20° C.) and it is measured in the conventional manner such as by the procedure set forth in "Experimental Physical Chemistry," by Daniels, Matthews and Williams, 3rd Edition (1941), pages 175 to 180.

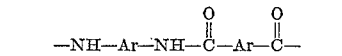
The polymers which are most useful in the practice of this invention are those which have the desired solubility and are composed of at least 50% of the following recurring structural units



and

wherein Ar is an arylene nucleus and R is either an alkylene or an arylene radical. Either Ar or R may contain substituent groups and still be useful in the practice of this invention. In addition, the polymers of this invention may contain mixtures of the above recurring units and blends of two or more of these polymers may also be used. When forming the polymers, therefore, one must merely select the proper reactants so that a major proportion of the polymeric chain is composed of the designated structural units.

In one of the preferred embodiments of this invention a wholly aromatic polyamide containing the recurring structural unit



wherein Ar is a phenylene nucleus, is dissolved in one of the said solvents with lithium or calcium chloride as the salt to give a solution which is suitable for the spinning of fibers or the casting of films.

In order to produce the compositions of matter of the present invention, it is merely necessary to select a polymer falling within the defined class and determine whether or not it is soluble to the extent of 0.5% by weight in the solvent (without the salt). If it is soluble to this extent in the solvent, any salt which dissociates in the solvent so as to liberate a bromide or chloride ion to the desired extent will materially increase the solubility of the polymer in the said solvent. The degree of dissociation is measured in terms of specific resistance by the method discussed in "Textbook of Physical Chemistry," by Samuel Glasstone, second edition, published April 1946, by D. Van Nostrand Company, Inc. (New York), on pages 888 to 892. After these determinations, the liquid compositions of matter of the present invention are formed by merely suspending the polymer, copolymer or blends of the polymers in the salt/solvent solution, although in some instances it may be desirable that the mixture be both heated and stirred in order to hasten the dissolving action of the salt/solvent solution.

The invention will now be further described in the following specific examples which are to be regarded solely as illustrative and not as restricting the scope of the invention.

Examples

The polymers in the following tables are prepared by reacting equimolar amounts of the two indicated reactants at room temperature. The resulting polymer is then stirred in the solvent at room temperature to determine the solubility. The specific resistances (S.RR.) was measured in accordance with the procedure set forth in "Experimental Physical Chemistry," by Daniels, Matthews and Williams, third edition (1941), pages 175 to 180.