[0010] Moreover, in the field of electronics and more particularly of lithography, concentrated polymer solutions are necessary for obtaining thick films (the thickness of which is typically greater than 30 nm) after deposition by the conventional "spin coating" method. Solutions with a low concentration of polymer do not make it possible to obtain films of such thickness with the conventional equipment currently present on lithography apparatus.

[0011] For these various reaons, this method appears complicated and costly to carry out on an industrial scale and does not enable sufficient elimination of all the contaminating elements.

[0012] Documents EP1132410, EP0544324 and EP0544325 describe methods for eliminating metals from a polymer solution by placing said polymer solution in contact with a highly acid ion-exchange resin, in particular a resin of sulfonic type having a structure based on styrene-vinylbenzene. These methods make it possible to obtain satisfactory results in terms of decontamination, but the applicant has sought an alternative improved method.

[Technical problem]

[0013] The aim of the ~~invention~~ embodiments disclosed herein is therefore to have an improved method enabling the treatment of viscous organic solutions, even if just to improve the productivity ~~of these~~ viscous solutions consisting of solvent(s) and optionally comprising one or more polymer(s), said polymer(s) being at high concentrations in the solutions and/or having a high molar mass.

[0014] The applicant has now discovered that viscous solutions, the viscosity of which at 20°C is between 1 and 1000 cP, possibly containing polymers or copolymers and being contaminated with metals, in metallic, ionic or complexed form, may be separated from these metals by using materials which trap these metals in metallic, ionic or complexed form, in a continuous and rapid method.

[Brief description ~~of the invention~~]

[0015] The present ~~invention~~ disclosure relates to a method for eliminating metal ions from a viscous organic solution, the viscosity of which at 20°C is between 1 and 1000 cP, said method being characterized in that it comprises the steps consisting in placing a macroporous ion-exchange resin in a column, said resin comprising at least one acid resin

of carboxylic type, based on a copolymer having active groups in carboxylic form (CO_2H), then in continuously passing the viscous organic solution over said ion-exchange resin.

[0015a] In an aspect, there is provided a method for eliminating metal ions from a viscous organic solution, comprising a solvent or a mixture of organic solvents and a polymer or a mixture of polymers, the viscosity of which at 20°C is between 1 cP and 1000 cP, said method being characterized in that it comprises the steps consisting in placing a macroporous ion-exchange resin in a column, said resin comprising at least one acid resin of carboxylic type, based on a polystyrene divinylbenzene copolymer having active groups in carboxylic form (CO_2H), then in continuously passing the viscous organic solution over said ion-exchange resin.

[0016] Thus, the metals present in the viscous solution are exchanged with the protons of the acid resin, until the content of each of the metals present in solution is less than 100 ppb and preferably less than 10 ppb.

[0017] According to other optional characteristics of the method:

- the resin is entirely composed of an acid resin of carboxylic type, based on a copolymer having active groups in carboxylic form (CO_2H),
- the contact time between the viscous organic solution and the ion-exchange resin is between 1 minute and 12 hours, preferably between 10 minutes and 4 hours,
- the ion-exchange resin has a porosity of between 100 Å and 600 Å,
- the ion-exchange resin has a specific surface area of between 20 and 600 m^2/g,
- the ion-exchange resin has an active group concentration of between 0.7 eq/l and 10eq/l and preferably of between 0.7 eq/l and 5 eq/l,
- the viscosity of the viscous organic solution is between 5 and 1000 cP at 20°C, and even more preferably between 5 and 400 cP at 20°C,
- the viscous organic solution to be decontaminated is brought into contact with the ion-exchange resin at a temperature ranging from 18 à 120°C,
- the viscous organic solution comprises a solvent or a mixture of organic solvents,
- the viscous organic solution also comprises a polymer or a mixture of polymers,

- at least one other macroporous ion-exchange resin is placed in said column, said other resin being a basic resin comprising active groups either in amine form, of dimethylamino type, or in quaternary ammonium form,

- the method also consists in pumping the viscous organic solution at the outlet of the column and reinjecting it at the top of the column to cause the viscous organic solution to circulate for several passes over said ion-exchange resin, until a predetermined contact time of between 1 minute and 12 hours, preferably between 10 minutes and 4 hours, is reached.

[0018] Other distinctive features and advantages of the disclosure~~invention~~ will become apparent on reading the description given by way of illustrative and non-limiting example, with reference to the appended figures, which represent:

- Figure 1: curves representing the dynamic viscosity at 20°C of an organic solution comprising an acrylic polymer, of high molar mass, at different concentrations,
- Figure 2: two curves each representing the dynamic viscosity at 20°C of a solution comprising a polymer, both solutions comprising an identical concentration of polymer, but the polymer of one of the solutions having a higher molar mass than the polymer of the other solution,
- Figure 3: mass spectra, respectively, of a polymer solution S4, after passage over a highly acid resin of sulfonic type, and a solvent blank solution.

[Detailed description of the invention]

[0019] The term "viscous organic solution" is intended to mean here an organic solution, the viscosity of which, measured at 20°C, is between 1 and 1000 cP (centipoise), preferably between 5 and 400 cP.

[0020] The term "polymer" is intended to mean either a copolymer of random, gradient, block or alternating type or a homopolymer.

[0021] The term "metals", as used, encompasses alkali metals, alkaline-earth metals, transition metals, post-transition metals, and metalloids.

[0022] The applicant has found, in the present invention, that it is possible to eliminate the metal ions from a viscous organic solution by treating it continuously, by passing over an ion-exchange resin of acid type. Thus, any cation M^{n+} (n being an integer greater than or equal to 1) contained in the viscous organic solution is retained and exchanged with protons nH^+ of a sulfonic resin comprising active groups in sulfonic form (SO_3H) or of a carboxylic resin comprising active groups in carboxylic form (CO_2H).

[0023] Preferably, the sulfonic or carboxylic resin is based on a polystyrene/divinylbenzene copolymer. This is because these resins have a backbone that is resistant to chemical attacks by the various organic solvents. These resins are generally defined by their divinylbenzene (DVB) content. Indeed, the latter determines the degree of crosslinking of the resin and hence the size of the pores in which the cation exchange