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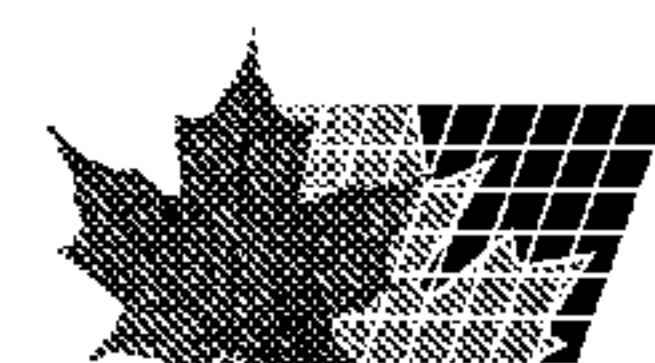
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(54) Title: ROOM TEMPERATURE CURING SYSTEM

(57) **Abrégé/Abstract:**

The present invention relates to a nitrite polymer composition comprising at least one carboxylated nitrite rubber polymer, that is optionally hydrogenated, at least one curing agent, and optionally at least one solvent, a process for preparing said polymer composition comprising at least one hydrogenated carboxylated nitrite rubber polymer, at least one curing agent, and optionally at least one solvent comprising the steps of hydrogenating at least one carboxylated nitrite rubber polymer in solution, optionally purifying said solution, and admixing it with at least one curing agent and a self-supporting shaped article comprising said compound optionally layered on or interposed between one or more supporting means. In still another of its aspects, the present invention relates to a sealant composition comprising said nitrite polymer composition.



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**Abstract**

The present invention relates to a nitrile polymer composition comprising  
5 at least one carboxylated nitrile rubber polymer, that is optionally  
hydrogenated, at least one curing agent, and optionally at least one solvent, a  
process for preparing said polymer composition comprising at least one  
hydrogenated carboxylated nitrile rubber polymer, at least one curing agent,  
and optionally at least one solvent comprising the steps of hydrogenating at  
10 least one carboxylated nitrile rubber polymer in solution, optionally purifying  
said solution, and admixing it with at least one curing agent and a self-  
supporting shaped article comprising said compound optionally layered on or  
interposed between one or more supporting means. In still another of its  
aspects, the present invention relates to a sealant composition comprising said  
15 nitrile polymer composition.

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## Room temperature curing system

### Field of the Invention.

The present invention relates to a nitrile polymer composition comprising  
5 at least one carboxylated nitrile rubber polymer, that is optionally  
hydrogenated, at least one curing agent, and optionally at least one solvent, a  
process for preparing said polymer composition comprising at least one  
hydrogenated carboxylated nitrile rubber polymer, at least one curing agent,  
and optionally at least one solvent comprising the steps of hydrogenating at  
10 least one carboxylated nitrile rubber polymer in solution, optionally purifying  
said solution, and admixing it with at least one curing agent and a self-  
supporting shaped article comprising said compound optionally layered on or  
interposed between one or more supporting means. In still another of its  
aspects, the present invention relates to a sealant composition comprising said  
15 nitrile polymer composition.

### Background of the Invention

Carboxylated hydrogenated nitrile rubber (HXNBR), prepared by the  
selective hydrogenation of carboxylated acrylonitrile-butadiene rubber (nitrile  
20 rubber; XNBR, a co-polymer comprising at least one conjugated diene, at least  
one unsaturated nitrile, at least one carboxylated monomer and optionally  
further comonomers) and XNBR itself, are specialty rubbers which have very  
good heat resistance, excellent ozone and chemical resistance, and excellent  
oil resistance. Coupled with the high level of mechanical properties of the  
25 rubber (in particular the high resistance to abrasion) it is not surprising that  
XNBR and HXNBR have found widespread use in the automotive (seals,  
hoses, bearing pads) oil (stators, well head seals, valve plates), electrical  
(cable sheathing), mechanical engineering (wheels, rollers) and shipbuilding  
(pipe seals, couplings) industries, amongst others.

30 Most commercially available curable compositions comprising XNBR  
and/or HXNBR require elevated temperatures for curing/cross-linking which

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sometimes is not desirable and/or not possible, in particular when the intended use is as adhesive, coating or sealant.

Adhesives (glues) are substances capable of forming and maintaining a bond between two surfaces, and sealants (caulks) are substances used to fill  
5 gaps or joints between two materials to prevent the passage of liquids, solids or gases. These two classes of materials are often considered together because quite frequently a given formulation performs the both functions.

Sealants are available as one-component solvent evaporation curing products and as chemical curing systems. With one-component solvent  
10 evaporation curing products there is no curing process, the compound gets its functionality through solvent loss and/or a decrease in temperature. When a sealant is applied, the solvent evaporates or migrates into porous substrates and the tough, rubbery compound is left in place. This is in contrast to other sealant types that cure chemically.

15 XNBR and/or HXNBR coatings are desirable whenever the very good heat resistance, excellent ozone and chemical resistance, and excellent oil resistance provided by the XNBR and/or HXNBR should be transferred to substrates such as plastics, rubbers, metal, glass and so on.

U.S. Pat. No 4,774,288 discloses a hydrogenated copolymer of a  
20 conjugated diene and an alpha-beta-unsaturated nitrile containing an active phenol-formaldehyde resin vulcanization system. The disclosure is directed to the bulk vulcanizate, which is characterized as having good compression set properties and a good resistance to oils and good resistance to oxidative attack in air at elevated temperature aging under oxidizing conditions, however no  
25 mention is made suggesting coatings could be formed on flexible elastomeric substrates such as natural rubber and polybutadiene which might provide useful properties.

U.S. Pat. No. 5,314,741 discloses a coating composition including a latex of highly saturated polymer such as hydrogenated nitrile rubber, highly  
30 saturated styrene-butadiene copolymer, hydrogenated polybutadiene, or hydrogenated styrene-vinylpyridine-butadiene terpolymer. The coating is applied to a substrate and cured in place to yield a desired coated article reportedly resistant to ozone, oxygen, and UV light. Suitable curatives taught

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are zinc-sulfur cure packages. Elevated temperatures are utilized to affect curing of these coatings. Moreover, conventional vulcanizing systems high in sulfur content and low vulcanization accelerator content, or semi-efficient vulcanizing system having a moderate dosage of sulfur and vulcanizates  
5 accelerator have several drawbacks. Conventional vulcanizing systems resulting in vulcanizates with good resistance to dynamic stresses (flex life) are very sensitive to aging and reversion. Semi-efficient vulcanizing systems usually give vulcanizates which have a less of a resistance to dynamic stresses (flex life), but, in return, they are somewhat more stable to aging and reversion.

10 U.S. Pat. No. 5,314,955 discloses a coating composition consisting of a hydrogenated acrylonitrile-butadiene copolymer, a phenolic resin, a curing component, and a solvent. This coating solves many of the problems of adhesion to rubber substrates combined with fatigue resistance and fuel resistance. One of the drawbacks of this coating composition is that it requires  
15 a high temperature bake to cure the coating and to promote adhesion to adjacent metal surfaces. A high temperature bake requires heat soaking of the entire article to be coated. Some parts such as helicopter rotor bearings would be damaged by a high temperature bake, therefore coatings such as taught in '955 are not practical to apply. The high temperature bake is also costly in  
20 production since it adds a time delay and additional handling of the parts.

US-Appl. No. 2003/0152790-A1 discloses a coating composition comprising a functionalized hydrogenated acrylonitrile-butadiene copolymer, (functionalized HNBR), a curing component which contains at least one isocyanate group, preferably a polyisocyanate, or at least one isocyanate  
25 group and a group which forms crosslinks, and a solvent. As the skilled in the art is well aware of, isocyanates are harmful substances often linked to cancer development.

A need exists for an improved protective coating for flexible elastomeric substrates which provide improved adhesion to the surface of elastomers, and  
30 improved flex-resistance.

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### Summary of the Invention

In one of it's aspects, the present invention relates to a nitrile polymer composition comprising (a) at least one carboxylated nitrile rubber polymer, that is optionally hydrogenated, (b) at least one compound containing 2 or  
5 more aziridine functional groups, and (c) optionally at least one solvent.

In another one of it's aspects, the present invention relates to a process for preparing said polymer composition comprising (a) at least one hydrogenated carboxylated nitrile rubber polymer, (b) at least one compound containing 2 or more aziridine functional groups, and (c) at least one solvent  
10 comprising the steps of hydrogenating at least one carboxylated nitrile rubber polymer in solution, optionally purifying said solution, and admixing it with at least one compound containing 2 or more aziridine functional groups.

In still another one of it's aspects, the present invention relates to a self-supported shaped article comprising said nitrile polymer composition  
15 comprising (a) at least one carboxylated nitrile rubber polymer, that is optionally hydrogenated, (b) at least one compound containing 2 or more aziridine functional groups, and (c) optionally at least one solvent optionally layered on or interposed between one or more supporting means.

In still another of its aspects, the present invention relates to a sealant  
20 composition comprising said nitrile polymer composition comprising (a) at least one carboxylated nitrile rubber polymer, that is optionally hydrogenated, (b) at least one compound containing 2 or more aziridine functional groups, and (c) optionally at least one solvent.

### Brief Description of the Drawings

Fig. 1 shows the RPA 2000 Tan Delta curves @ 100 °C for Examples 1-6.

### Description of the Invention

As used throughout this specification, the term "carboxylated nitrile  
30 polymer" or XNBR is intended to have a broad meaning and is meant to encompass a copolymer having repeating units derived from at least one conjugated diene, at least one alpha-beta-unsaturated nitrile, at least one at

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least one monomer having a carboxylic group and optionally further one or more copolymerizable monomers.

The conjugated diene may be any known conjugated diene, in particular a C<sub>4</sub>-C<sub>6</sub> conjugated diene. Preferred conjugated dienes are butadiene, isoprene, piperylene, 2,3-dimethyl butadiene and mixtures thereof. Even more preferred C<sub>4</sub>-C<sub>6</sub> conjugated dienes are butadiene, isoprene and mixtures thereof. The most preferred C<sub>4</sub>-C<sub>6</sub> conjugated diene is butadiene.

The alpha-beta-unsaturated nitrile may be any known alpha-beta-unsaturated nitrile, in particular a C<sub>3</sub>-C<sub>5</sub> alpha-beta-unsaturated nitrile. Preferred C<sub>3</sub>-C<sub>5</sub> alpha-beta-unsaturated nitriles are acrylonitrile, methacrylonitrile, ethacrylonitrile and mixtures thereof. The most preferred C<sub>3</sub>-C<sub>5</sub> alpha-beta-unsaturated nitrile is acrylonitrile.

The monomer having at least one carboxylic group may be any known monomer having at least one carboxylic group being copolymerizable with the nitrile and the diene.

Preferred monomers having at least one carboxylic group are unsaturated carboxylic acids. Non-limiting examples of suitable unsaturated carboxylic acids are fumaric acid, maleic acid, acrylic acid, methacrylic acid and mixtures thereof.

Preferably, the copolymer comprises in the range of from 40 to 85 weight percent of repeating units derived from one or more conjugated dienes, in the range of from 15 to 60 weight percent of repeating units derived from one or more unsaturated nitriles and in the range of from 0.1 to 15 weight percent of repeating units derived from one or more monomers having at least one carboxylic group. More preferably, the copolymer comprises in the range of from 55 to 75 weight percent of repeating units derived from one or more conjugated dienes, in the range of from 25 to 40 weight percent of repeating units derived from one or more unsaturated nitriles and in the range of from 1 to 7 weight percent of repeating units derived from one or more monomers having at least one carboxylic group.

Optionally, the copolymer may further comprise repeating units derived from one or more copolymerizable monomers, such as alkylacrylate, styrene. Repeating units derived from one or more copolymerizable monomers will

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replace either the nitrile or the diene portion of the nitrile rubber and it will be apparent to the skilled in the art that the above mentioned figures will have to be adjusted to result in 100 weight percent.

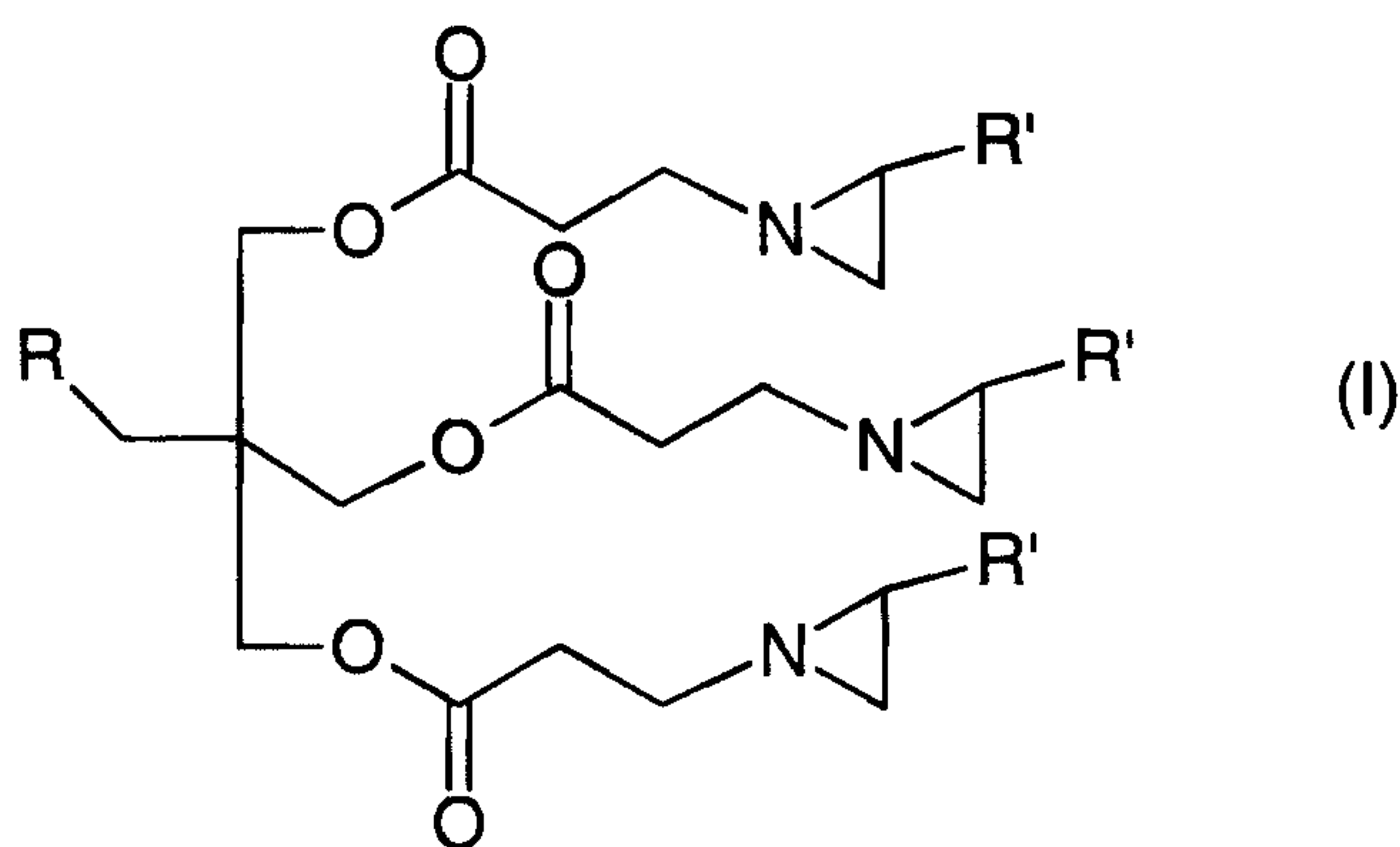
Hydrogenated in this invention is preferably understood by more than  
5 50 % of the residual double bonds (RDB) present in the starting nitrile polymer/NBR being hydrogenated, preferably more than 90 % of the RDB are hydrogenated, more preferably more than 95 % of the RDB are hydrogenated and most preferably more than 99 % of the RDB are hydrogenated.

The present invention is not restricted to a special process for preparing  
10 the hydrogenated carboxylated NBR. However, the HXNBR preferred in this the invention is readily available as disclosed in WO-01/77185-A1. For jurisdictions allowing for this procedure, WO-01/77185-A1 is incorporated herein by reference.

The XNBR as well as the HXNBR which forms a preferred component of  
15 the polymer compound of the invention can be characterized by standard techniques known in the art. For example, the molecular weight distribution of the polymer was determined by gel permeation chromatography (GPC) using a Waters 2690 Separation Module and a Waters 410 Differential Refractometer running Waters Millennium software version 3.05.01. Samples were dissolved  
20 in tetrahydrofuran (THF) stabilized with 0.025% BHT. The columns used for the determination were three sequential mixed-B gel columns from Polymer Labs. Reference Standards used were polystyrene standards from American Polymer Standards Corp.

The inventive polymer composition further comprises at least one  
25 compound containing 2 or more aziridine functional groups. Compounds containing 2 or more aziridine functional groups are known to the skilled in the art and any of these should be suitable for the present invention. However, compounds of formula (I)

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in which R is hydrogen, C<sub>1</sub> to C<sub>50</sub> hydrocarbon that may be saturated or unsaturated, cyclic or non-cyclic, and may further comprise heteroatoms and each R' is independently hydroxyl, or C<sub>1</sub> to C<sub>50</sub> hydrocarbon that may be saturated or unsaturated, cyclic or non-cyclic, and may further comprise heteroatoms. Preferred are compounds with R = H or CH<sub>3</sub> and R' = OH or CH<sub>3</sub>. These compounds are commercially available from Bayer Inc. under the tradenames PFAZ® and XAMA®.

Although the inventive carboxylated nitrile polymer composition does not require the presence of solvent, the absence of solvent does requires extra care to prevent undesired cross-linking during mixing. Therefore, the inventive polymer composition preferably further comprises at least one solvent. The solvent is not critical to the result and may be any solvent that does dissolve the, optionally hydrogenated, carboxylated nitrile polymer(s) and the compound(s) containing 2 or more aziridine functional groups. Suitable examples of such solvents are ketones such as methylethyl ketone, methylisobutyl ketone, and diisobutyl ketone; acetates such as butyl acetate; toluene, xylene and their derivatives; or chlorinated aromatic hydrocarbons such as monochlorobenzene. The concentration of the solution is not critical and must be such as to allow convenient application or processing of the solution.

The carboxylated nitrile polymer compositions of the present invention can be cured to form substantially clear or transparent films/shaped articles/coatings when pigments are excluded. Alternatively, optional and preferred dyes or pigments can be readily incorporated. Colored coatings provided in accordance with the invention provide outstanding color and

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coating physical properties for long-term weathering uses. An extensive list of organic and inorganic pigments suitable for adding to rubber can be found in the current volume of the Rubber Blue Book, published by Lippincott & Peto Publications and well known to those versed in the art of formulating elastomers. As a brief overview, inorganic pigments such as iron oxide (rust red), chrome oxide (green), titanium dioxide or zinc oxide (white), ultramarine blue, and aluminum powder (silver) are used to make opaque coatings.

The inventive carboxylated nitrile rubber composition further optionally comprises at least one filler. The filler may be an active or an inactive filler or a mixture thereof. The filler may be in particular:

- highly dispersed silicas, prepared e.g. by the precipitation of silicate solutions or the flame hydrolysis of silicon halides, with specific surface areas of in the range of from 5 to 1000 m<sup>2</sup>/g, and with primary particle sizes of in the range of from 10 to 400 nm; the silicas can optionally also be present as mixed oxides with other metal oxides such as those of Al, Mg, Ca, Ba, Zn, Zr and Ti;
- synthetic silicates, such as aluminum silicate and alkaline earth metal silicate like magnesium silicate or calcium silicate, with BET specific surface areas in the range of from 20 to 400 m<sup>2</sup>/g and primary particle diameters in the range of from 10 to 400 nm;
- natural silicates, such as kaolin and other naturally occurring silica;
- glass fibers and glass fiber products (matting, extrudates) or glass microspheres;
- metal oxides, such as zinc oxide, calcium oxide, magnesium oxide and aluminum oxide;
- metal carbonates, such as magnesium carbonate, calcium carbonate and zinc carbonate;
- metal hydroxides, e.g. aluminum hydroxide and magnesium hydroxide;
- carbon blacks; the carbon blacks to be used here are prepared by the lamp black, furnace black or gas black process and have preferably BET (DIN 66 131) specific surface areas in the range of

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from 20 to 200 m<sup>2</sup>/g, e.g. SAF, ISAF, HAF, FEF or GPF carbon blacks;

- rubber gels, especially those based on polybutadiene, butadiene/styrene copolymers, butadiene/acrylonitrile copolymers and polychloroprene;

or mixtures thereof.

Examples of preferred mineral fillers include silica, silicates, clay such as bentonite, gypsum, alumina, titanium dioxide, talc, mixtures of these, and the like. These mineral particles have hydroxyl groups on their surface, rendering them hydrophilic and oleophobic. This exacerbates the difficulty of achieving good interaction between the filler particles and the rubber. For many purposes, the preferred mineral is silica, especially silica made by carbon dioxide precipitation of sodium silicate. Dried amorphous silica particles suitable for use in accordance with the invention may have a mean agglomerate particle size in the range of from 1 to 100 microns, preferably between 10 and 50 microns and most preferably between 10 and 25 microns. It is preferred that less than 10 percent by volume of the agglomerate particles are below 5 microns or over 50 microns in size. A suitable amorphous dried silica moreover usually has a BET surface area, measured in accordance with DIN (Deutsche Industrie Norm) 66131, of in the range of from 50 and 450 square meters per gram and a DBP absorption, as measured in accordance with DIN 53601, of in the range of from 150 and 400 grams per 100 grams of silica, and a drying loss, as measured according to DIN ISO 787/11, of in the range of from 0 to 10 percent by weight. Suitable silica fillers are available under the trademarks HiSil® 210, HiSil® 233 and HiSil® 243 from PPG Industries Inc. Also suitable are Vulkasil® S and Vulkasil® N, from Bayer AG.

Often, use of carbon black as a filler is advantageous. Usually, carbon black is present in the polymer composite in an amount of in the range of from 20 to 200 parts by weight, preferably 30 to 150 parts by weight, more preferably 40 to 100 parts by weight. Further, it might be advantageous to use a combination of carbon black and mineral filler in the inventive polymer composite. In this combination the ratio of mineral fillers to carbon black is usually in the range of from 0.05 to 20, preferably 0.1 to 10.

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The carboxylated nitrile rubber composition may advantageously further comprise other natural or synthetic polymer(s) containing functional groups capable of reacting with the polyaziridine compound, such as carboxylated alpha olefin-vinyl acetate and alpha olefin-vinyl acrylate copolymers (e.g. carboxylated EVA or EVAc). Careful blending with conventional HNBR often reduces cost of the polymer composite without sacrificing the processability. The amount of conventional HNBR and/or other natural or synthetic rubbers will depend on the process condition to be applied during manufacture of shaped articles and is readily available by few preliminary experiments.

The rubber composition according to the invention can contain further auxiliary products for rubbers, such as antioxidants, foaming agents, anti-aging agents, heat stabilizers, light stabilizers, ozone stabilizers, processing aids, plasticizers, tackifiers, blowing agents, waxes, extenders,, inhibitors, metal oxides, and activators such as triethanolamine, polyethylene glycol, hexanetriol, etc., which are known to the rubber industry. The rubber aids are used in conventional amounts, which depend inter alia on the intended use. Conventional amounts are e.g. from 0.1 to 50 wt.%, based on rubber.

In another one of it's aspects, the present invention relates to a process for preparing a polymer composition comprising (a) at least one hydrogenated carboxylated nitrile rubber polymer, (b) at least one compound containing 2 or more aziridine functional groups, and (c) at least one solvent comprising the steps of hydrogenating at least one carboxylated nitrile rubber polymer in solution, optionally purifying said solution, and admixing it with at least one compound containing 2 or more aziridine functional groups.

The XNBR must be hydrogenated to result in a partially or fully hydrogenated nitrile polymer (HXNBR). HXNBR are preferred in the present invention. Reduction can be effected using standard reduction techniques known in the art. For example, homogeneous hydrogenation catalysts known to those of skill in the art, such as Wilkinson's catalyst  $\{(PPh_3)_3RhCl\}$  and the like can be used.

The hydrogenation is performed in solution. The XNBR is either provided to the reaction vessel in a dissolved state in a suitable solvent and the

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hydrogenation catalyst is simply added to the vessel, which is then treated with hydrogen to produce the HXNBR.

Usually, Wilkinson's catalyst is used for the hydrogenation step. Details of this process are known and e.g. can be found in CA-2,357,470.

5        After the hydrogenation, the HXNBR is recovered from the solution and dried. While this a suitable step in the inventive process, the HXNBR is preferably not recovered from solution but is instead used as is to prepare the nitrile polymer composition comprising (a) at least one hydrogenated carboxylated nitrile rubber polymer, (b) at least one compound containing 2 or  
10 more aziridine functional groups, and (c) at least one solvent comprising the steps of hydrogenating at least one carboxylated nitrile rubber polymer in solution, optionally purifying said solution, by simply admixing the polymer solution with at least one compound containing 2 or more aziridine functional groups and optionally further ingredients.

15        The ingredients of the final polymer composition are mixed together, suitably at a temperature that may range from 15 °C to 40 °C. Normally the mixing time does not exceed one hour and a time in the range from 2 to 30 minutes is usually adequate. The mixing is suitably carried out in an internal mixer such as a Banbury mixer, or a Haake or Brabender miniature internal  
20 mixer. A two roll mill mixer also provides a good dispersion of the additives within the elastomer. An extruder also provides good mixing, and permits shorter mixing times. It is possible to carry out the mixing in two or more stages, and the mixing can be done in different apparatus, for example one stage in an internal mixer and one stage in an extruder. However, it should be  
25 taken care that no unwanted pre-crosslinking (= scorch) occurs during the mixing stage. For compounding and vulcanization see also: Encyclopedia of Polymer Science and Engineering, Vol. 4, p. 66 et seq. (Compounding) and Vol. 17, p. 666 et seq. (Vulcanization).

30        As the inventive the carboxylated nitrile rubber composition cures at room temperatures, in particular above 0 °C, more preferred above 20 °C, the present invention is specifically directed towards a nitrile polymer composition comprising (a) at least one carboxylated nitrile rubber polymer, that is optionally hydrogenated, (b) at least one compound containing 2 or more aziridine

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functional groups, and (c) optionally at least one solvent curable at temperatures in the range of from 0-100 °C , in particular 15–65 °C, even more preferred in the range of from 25-40 °C. The composition will cure within 2 to 200 hours at room temperature. The cure can be accelerated by exposing the  
5 composition to elevated temperatures, but this is not required.

The priming composition and/or the nitrile polymer composition can be applied to a substrate (for example a tape substrate) by many different methods, including solvent coating, solvent spraying, emulsion coating, low pressure coating or other processes known to the person skilled in the art.  
10 Suitable substrates include metal, glass, wood, stone, plastic, in particular polyolefin films (e.g. polyethylene and polypropylene films), in particular corona-treated polyolefin films, and paper saturated with elastomer. The suitable coating weight is in the range from 0.1 to 5 mg/cm<sup>2</sup>, preferably from 0.2 to 1.0 mg/cm<sup>2</sup>, and more preferably from 0.3 to 0.5 mg/cm<sup>2</sup>. When the  
15 priming layer has been applied to a substrate, it is then preferably dried. This drying preferably takes place at elevated temperature, under reduced pressure, or both.

A further preferred method for the production of coated substrates is co-extrusion coating, which is normally carried out in a coating device with a  
20 solution of the nitrile polymer composition that is applied via a flat-sheeting die to a substrate that may consist of one or more polymer layers. The composite that is thereby formed is then cured in a curing/press roll unit and smoothed. The composite strip material is then coiled in a corresponding coiling machine.

In another preferred embodiment, the inventive composition may  
25 be prepared by simply mixing the ingredients by hand with a spatula or the like or by mechanical mixing or shaking. The final composition is typically applied to a substrate by dipping, spraying, wiping, brushing or the like, after which the composition is allowed to dry for a period of time typically ranging from 30 minutes to 2 hours, preferably from 45 minutes to 1 hour. The composition is  
30 typically applied to form a dry layer on the substrate having a thickness ranging from 0.1 to 5 mm, preferably from about 0.5 to 1.5 mm. The coating compositions can be applied to substrates which have been vulcanized or to

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uncured substrates and co-cured therewith, at elevated temperatures if necessary.

Yet another aspect of the invention is a sealant composition comprising said nitrile polymer composition.

5       The sealant system is preferably a high solids system, where the composition is usually provided with a low amounts of solvent as possible. The sealant composition is applied on or between the materials to seal or glue.

Self-supporting shaped articles, such as tapes are especially useful in architectural work and for insulating glass sealing. High solids systems  
10       comprising the inventive compound are especially useful as insulation sealants for glass windows and doors. Further areas of application include: automotive industry, especially applications under the hood and/or at higher ambient temperatures, building/construction, bridges, roads, transport, woodworking and wood bonding, bookbinding, graphic industry, packaging industry,  
15       disposable articles, laminates, shoe manufacture, end customer adhesive applications, and in the sealant and insulating industry.

The compound of the invention remains flexible, and is especially recommended for applications at elevated temperatures.

Furthermore, the inventive compound may be used in the manufacture  
20       of a shaped article comprising said inventive polymer compound. Preferred shaped articles are a seal, hose, bearing pad, stator, well head seal, valve plate, cable sheating, wheel roller, pipe seal, in place gaskets or footwear component prepared by injection molding technology. Furthermore, the inventive polymer composite is very well suited for wire and cable production  
25       tires, bumpers, wiper blades, vibration isolators, rubber mounts, rail track pad fasteners, helicopter rotor bearings, chassis mounts, wiper frames, gaskets, heels, shoe soles, printing rolls, belts, fuel tanks, moldings, facias, and other engineered rubber goods.

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**EXAMPLES***Basic chemistry***Examples 1-5**

- 5            Examples 1-5 were based on a 15% (total solids) solution of Therban® XT™ in methyl-ethyl-ketone.

The polyaziridine PFAZ 322 was added to the XT solution as a pure liquid and mixed for 15 minutes. The samples were dried under vacuum at room temperature.

- 10           Example 6 was mixed on a cold mill (20°C) for 5 minutes and then tested. Example 1 is for comparison. Formulations are shown in Table 1

Table 1

|                                    | Comp.<br>Ex. 1 | Ex. 2 | Ex. 3 | Ex. 4 | Ex. 5 | Ex. 6 |
|------------------------------------|----------------|-------|-------|-------|-------|-------|
| Therban® XT™ solution              | 1000           | 1000  | 1000  | 1000  | 1000  | N/A   |
| Therban® XT™ (polymer weight in g) | 150            | 150   | 150   | 150   | 150   | 150   |
| PFAZ 322 (phr)                     | 0              | 0.5   | 2.5   | 5     | 10    | 0.5   |
| PFAZ 322 (weight, g)               | 0              | 0.75  | 3.75  | 7.5   | 15.0  | 0.75  |

PFAZ 322 is a tri-functional aziridine available from Bayer.

The solution is stable for at least 1 hour at room temperature.

- 15           The dried cured polymer are insoluble (tested in MCB, MEK THF).

- 20           Figure 1 shows the Tan delta curves for examples 1-6. Tan delta gives an indication of the cross-linking density. A lower Tan delta indicates a higher elastic modulus resulting from increased cross-linking. As can be seen in figure 1, an increase in the polyaziridine content results in an increase in cross-linking density. Additionally examples 2 and 6 have very similar behavior

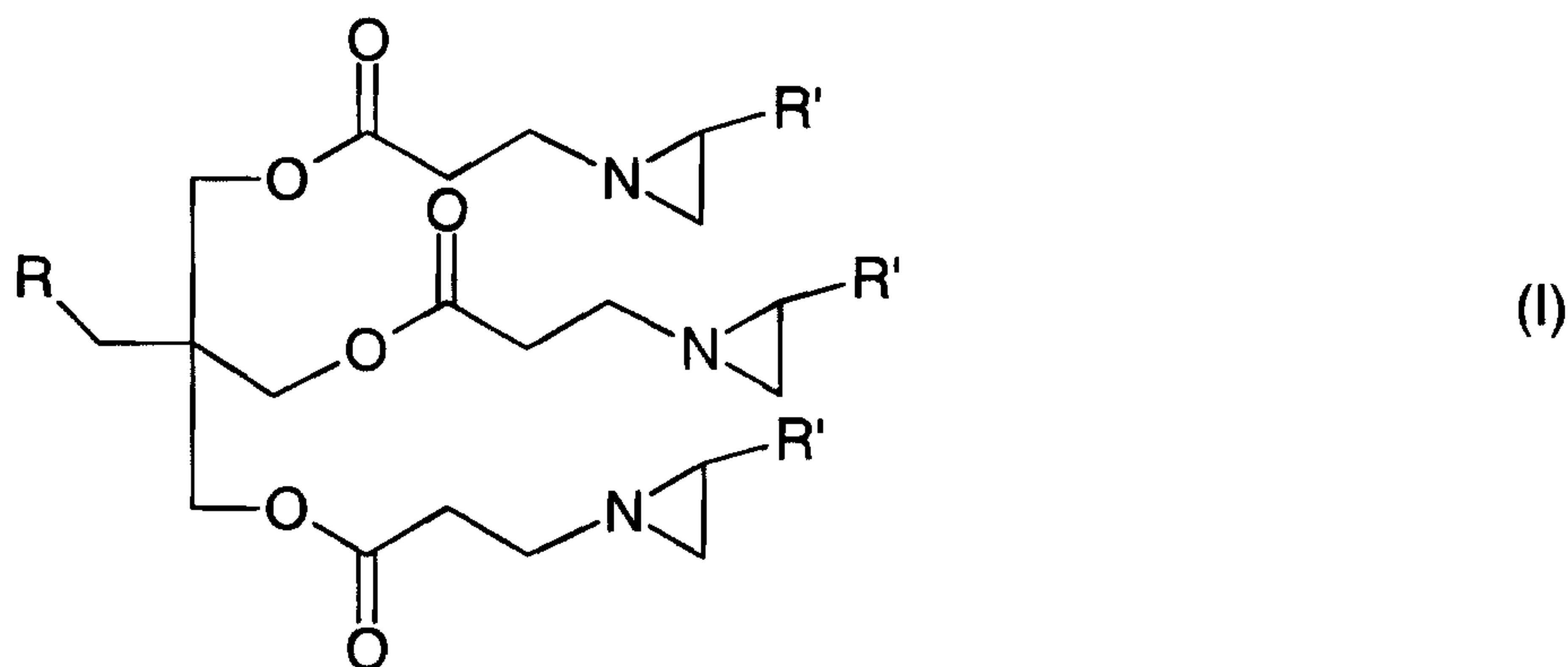
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indicating that the cross-linking mechanism can be used using rubber mixing methods or solution reaction.

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**Claims**

1. A nitrile polymer composition comprising (a) at least one carboxylated nitrile rubber polymer, that is optionally hydrogenated, (b) at least one compound containing 2 or more aziridine functional groups, and (c) optionally at least one solvent.
2. A nitrile polymer composition according to claim 1 comprising at least one hydrogenated carboxylated nitrile rubber polymer.
3. A nitrile polymer composition according to claim 1 or 2 further comprising at least one carboxylated alpha olefin-vinyl acetate and alpha olefin-vinyl acrylate copolymers.
4. A polymer composition according to any of claims 1 to 3 comprising at least one solvent.
5. A polymer composition according to any of claims 1-3 wherein the compound containing 2 or more aziridine functional groups is a compound of formula (I),



in which R is hydrogen, C<sub>1</sub> to C<sub>50</sub> hydrocarbon that may be saturated or unsaturated, cyclic or non-cyclic, and may further comprise heteroatoms and each R' is independently hydroxyl, or C<sub>1</sub> to C<sub>50</sub> hydrocarbon that may be saturated or unsaturated, cyclic or non-cyclic, and may further comprise heteroatoms.

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- 5 6. A process for preparing said polymer composition comprising (a) at least one hydrogenated carboxylated nitrile rubber polymer, (b) at least one compound containing 2 or more aziridine functional groups, and (c) at least one solvent comprising the steps of hydrogenating at least one carboxylated nitrile rubber polymer in solution, optionally purifying said solution, and admixing it with at least one compound containing 2 or more aziridine functional groups.
- 10 7. A self-supported shaped article comprising said nitrile polymer composition comprising (a) at least one carboxylated nitrile rubber polymer, that is optionally hydrogenated, (b) at least one compound containing 2 or more aziridine functional groups, and (c) optionally at least one solvent optionally layered on or interposed between one or more supporting means.
- 15 8. An article according to claim 6, wherein the article further comprises at least one supporting means on which the compound is layered.
- 20 9. A shaped article comprising the compound of any of the claims 1-4.
10. An article according to claim 8 in the form of a seal, hose, bearing pad, stator, well head seal, valve plate, wire or cable sheating, wheel roller, pipe seal, in place gaskets or footwear component.
- 25 11. A sealant or adhesive composition comprising (a) at least one carboxylated nitrile rubber polymer, that is optionally hydrogenated, (b) at least one compound containing 2 or more aziridine functional groups, and (c) optionally at least one solvent.
- 30 12. A tire or tire component when coated with a nitrile polymer composition comprising (a) at least one carboxylated nitrile rubber polymer, that is

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optionally hydrogenated, (b) at least one compound containing 2 or more aziridine functional groups, and (c) optionally at least one solvent.

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Fig. 1

