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(71) Applicant: **CARL ZEISS VISION INTERNATIONAL GMBH** [DE/DE]; Turnstrasse 27, 73430 Aalen (DE).

(72) Inventors: **LIANG, Jingye**; Room 6H, JIAXIGE, YIAN Garden, YIAN Road, HAIZHU District, Guangzhou, Guangdong 510220 P.R. (CN). **OUYANG, Liu**; 18/1F 9th St, Clifford Estates Panyu district, Guangzhou, 511495 (CN).

(74) Agent: **CARL ZEISS AG - PATENTABTEILUNG**; Carl-Zeiss-Strasse 22, 73447 Oberkochen (DE).

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(54) Title: COATED LENS AND METHOD FOR MANUFACTURING THE SAME

(57) Abstract: A coated lens comprising a stamping is provided. A method for manufacturing a coated lens comprising a stamping is provided.

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Coated lens and method for manufacturing the same

Field of the invention

The present invention relates to a coated lens according to the preamble of claims 1, 2, 22 and 37 and to a method for manufacturing a coated lens according to the preamble of claims 47 and 58.

Related art

WO 2020/078964 A1, on which the invention is based, discloses an optical article comprising a base lens substrate and an abrasion resistant coating, the abrasion resistant coating forming at least one optical element protruding from one of the surfaces of the abrasion resistant coating. According to paragraph [063] of WO 2020/078964 A1, the abrasion resistant coating may be prepared from compositions comprising at least one alkoxysilane and/or one hydrolysate thereof, obtained by hydrolysis with a hydrochloric acid solution. According to paragraph [064], the abrasion resistant coating may be based on epoxysilane hydrolysates as described in EP 0 614 957 A1, US 4,211,823 and US 5,015,523. EP 0 614 957 A1 discloses in examples 1 to 4, comparative example 5, and examples 6 to 10 the use of methanol or colloidal silica in methanol, in example 11 additionally the use of toluene, in the respective composition for preparing the abrasion resistant coating. US 4,211,823 discloses in examples 1 to 3, 6, 8 to 11 the use of methanol silica sol, in example 4 the use of an aqueous colloidal silica condensate and ethyl alcohol, in examples 5 and 7 the use of an aqueous colloidal silica condensate and a mixture of isopropanol and n-butanol, in examples 12 and 13 the use of methanol silica sol, diacetonealcohol and n-butylalcohol, in examples 14, 15 and 20 the use of methanol silica sol and diacetonealcohol and benzylalcohol, in examples 16 and 17 the use of methanol silica sol and methanol, in example 18 and 19 the use of methanol silica sol, benzylalcohol and methanol in the respective composition for preparing the abrasion resistant coating. US 5,015,523 discloses the preparation of the silicon hard coating solutions H1 to H5 each containing colloidal silica in isopropanol or methanol and isopropanol, methanol and/or ethanol. Further, according to paragraphs [066] and [067] of WO 2020/078964 A1, the abrasion resistant coating may have a bi-layered structure as disclosed in EP 2 092 377 A1. All examples given in EP 2 092 377 A1 for the compositions of the lower layer and the upper layer of the respective abrasion resistant coating are each containing methanol, deionized water, 1-methoxypropan-2-ol and/or methyl ethyl ketone. According to paragraph [068] of WO 2020/078964 A1 the abrasion resistant coating that may be used in additive manufacturing or inkjet printing is disclosed in US 2007/0238804 A1. According to the examples given US 2007/0238804 A1 the solvents are distilled off before application.

WO 2020/078964 A1 describes several methods for manufacturing the optical article such as molding, additive manufacturing, or thermal embossing. Thermal embossing may be used when an optical article in which the optical elements protrude from a surface facing away from the base lens substrate is to be obtained. The abrasion resistant coating is applied to a surface by, for example, dip coating, UV or thermally cured and then embossed involving pressure and temperature. The optical elements may be regularly distributed along circles centered on the optical center of the refraction area:

- The optical elements on the circle of diameter 10 mm and centered on the optical center of the refraction area may be micro lenses having a mean sphere of 2.75 D.

- The optical elements on the circle of diameter 20 mm and centered on the optical center of the refraction area may be micro lenses having a mean sphere of 4.75 D.
- The optical elements on the circle of diameter 30 mm and centered on the optical center of the refraction area may be micro lenses having a mean sphere of 5.5 D.
- The optical elements on the circle of diameter 40 mm and centered on the optical center of the refraction area may be micro lenses having a mean sphere of 5.75 D.

EP 3 561 578 A1 discloses in figures 14a and 14b and describes in paragraph [0102] a spectacle lens having a clear zone and cylindrical concentric rings. No dimensions are given for the cylindrical concentric rings. According to paragraph [0161] of EP 3 561 578 A1 every circular zone should have a radius between 2 and 4 mm comprising a geometrical center located at a distance of the optical center of the spectacle lens greater or equal to said radius + 5 mm, the ratio between the sum of areas of the parts of cylindrical concentric rings located inside said circular zone and the area of said circular zone is comprised between 20% and 70%.

WO 2019/166659 A1 discloses in figures 11a and 11b and describes on page 20, lines 10 to 12, the same type of a spectacle lens having a clear zone and cylindrical concentric rings as mentioned before with respect to the figures 14a and 14b of EP 3 561 578 A1. Again, WO 2019/66659 A1, does not disclose dimensions for the cylindrical concentric rings. According to page 28, lines 13 to 18, the ratio, defined as in paragraph [0161] of EP 3 561 578 A1, is comprised between 20% and 70%, between 30% and 60%, or between 40% and 50%. Further, WO 2019/166659 A1 discloses in figure 1 and describes on page 20, lines 5 to 7, optical elements as micro lenses positioned along a set of five concentric rings. According to page 17, lines 1 to 5, the optical elements have a contour shape being inscribable in a circle having a diameter greater than or equal to 0.8 mm and smaller than or equal to 3.0 mm.

CN 111103701 A discloses in figure 3 a spectacle lens with a central optical region. Said central optical region is a circular region within a specified radius in the range of 5 mm to 10 mm. Outside of the central optical region, cylindrical microstructures are arranged in a ring-shaped manner. The radial widths of the cylindrical microstructures are specified to be in a range of 0.5 mm to 2 mm. The distance between the cylindrical microstructures of different rings is in the range of 0.5 mm to 3 mm.

Problem to be solved

The object of the present invention was to provide a spectacle lens comprising a structureable coating composition. Said structureable coating composition should be compatible with different optical materials and integrable into a common coating sequence of a spectacle lens. The object was further to provide an efficient method for manufacturing such a spectacle lens.

Summary of the invention

The problem is solved by the coated lens according to claims 1, 2, 22 and 37 as well as by the method according to claims 47 and 58.

Advantageous embodiments, which might be realized in an isolated fashion or in any arbitrary combination, are the subject-matter of the dependent claims.

The coated lens according to the invention comprises a coating composition, said coating composition comprises a stamping. Said coating composition comprises at least one component selected from the group consisting of at least one epoxide component and at least one (meth)acrylate component.

A coated lens is according to ISO 13666:2019(E), section 3.18.1, a lens to which one or more surface layers have been added to alter one or more properties of the lens. A lens or spectacle lens is according to ISO 13666:2019(E), section 3.5.2, an ophthalmic lens worn in front of, but not in contact with, the eyeball.

The coated lens comprises a coating, said coating comprises a stamping, said coating is based on a coating composition comprising at least one component selected from the group consisting of at least one epoxide component and at least one (meth)acrylate component, said stamping is having in a domain of said stamping a surface power which is different to a surface power of a lens surface of the coated lens comprising said coating outside said domain of said stamping.
The lens surface of the coated lens may be either a front surface or a back surface thereof. The surface power is as defined in ISO 13666:2019(E), section 3.10.4. The domain of the stamping is explained below with respect to the surface topography of the stamping.

Preferably, said coating composition comprises said at least one epoxide component and said at least one (meth)acrylate component in a weight ratio selected from at least one of the following ranges:
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.64 to 4.3,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.7 to 4.1,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.8 to 4.0,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 1.0 to 3.0.

Preferably, said coating composition comprises said at least one epoxide component in a total amount within a range selected from at least one of the following ranges:
- said total amount being within a range of from 39% by weight to 81% by weight,
- said total amount being within a range of from 45% by weight to 75% by weight,
- said total amount being within a range of from 50% by weight to 70% by weight,
- said total amount being within a range of from 55% by weight to 65% by weight,

each total amount of said at least one epoxide component being based on the total weight of the sum of said at least one epoxide component and said at least one (meth)acrylate component, and said at least one (meth)acrylate component in a total amount within a range selected from at least one of the following ranges:

- said total amount being within a range of from 19% by weight to 61% by weight,
- said total amount being within a range of from 25% by weight to 55% by weight,
- said total amount being within a range of from 30% by weight to 50% by weight,
- said total amount being within a range of from 35% by weight to 45% by weight,

each total amount of said at least one (meth)acrylate component being based on the total weight of the sum of said at least one epoxide component and said at least one (meth)acrylate component.

Preferably, said coating composition is having a viscosity within a range selected from at least one of the following ranges:

- said viscosity being within a range of from 50 mPas to 600 mPas,
- said viscosity being within a range of from 100 mPas to 500 mPas,
- said viscosity being within a range of from 150 mPas to 400 mPas,
- said viscosity being within a range of from 250 mPas to 350 mPas,
- each viscosity being determined using an Ubbelohde viscometer at a working temperature being within a range selected from at least one of the following ranges:
- said working temperature being within a range of from -20°C to 100°C,
- said working temperature being within a range of from 0°C to 60°C,
- said working temperature being within a range of from 10°C to 40°C,
- said working temperature being within a range of from 17°C to 30°C.

Coating composition refers to a state before cure. Coating refers to a state after cure.

Before cure, said coating composition is formable or structureable to result in said stamping. Before cure, said coating composition preferably is formable or structureable at a given working temperature, for example, at 22°C ± 0.5°C. Before cure, said coating composition preferably is additionally characterized by at least one of the following features selected from the group consisting of:

- Preferably said working temperature is within a range of from -20°C to 100°C, further preferably within a range of from 0°C to 60°C, further preferably within a range of from 10°C to 40°C, more preferably within a range of from 17°C to 30°C, and most preferably at ambient temperature.
- Preferably the viscosity of said coating composition at said working temperature is within a range of from 50 mPas to 600 mPas, further preferably within a range of from 100 mPas to 500 mPas, more preferably within a range of from 150 mPas to 400 mPas, and most preferably within a range of from 250 mPas to 350 mPas. The viscosity of said coating composition preferably is determined at said working temperature using an Ubbelohde viscometer.
- Preferably the yellowness index of said coating composition is within a range of from 0.5 to 10.0, further preferably from 0.5 to 6.0, more preferably from 0.5 to 5.0, most preferably from 0.5 to 4.0. The yellowness index preferably is measured in a quartz cuvette with a thickness of 2.0 mm using the spectrophotometer UltrascanPro, company HunterLab.

- Preferably said coating composition is involved in at least one curing reaction, preferably a UV curing reaction and/or a thermal curing reaction. Further preferably, said coating composition is in a first step precured via a UV curing reaction, i.e., the curing reaction is initialized by irradiation with UV light, and is in a subsequent second step cured via a thermal curing reaction.
- Preferably said coating composition is UV curable. UV curable means that said coating composition is precured in a wavelength selected from a wavelength range of from 365 nm to 460 nm, more preferably in the wavelength of 365 nm or in the wavelength of 400 nm, preferably by using a LED curing lamp, further preferably by using a LED curing lamp curing with a wavelength selected from a wavelength range of from 365 nm to 460 nm, more preferably with the wavelength of 365 nm or with the wavelength of 400 nm, each within a range of from 20s to 100s. UV curable further means that said coating composition is precured with a UV intensity or UV dose selected from a range of from 4 J/cm^2 to 20 J/cm^2, further preferably from 5 J/cm^2 to 17 J/cm^2, more preferably from 7 J/cm^2 to 15 J/cm^2 and most preferably from 9 J/cm^2 to 11 J/cm^2. UV curable preferably means that said coating composition is precured by using a LED curing lamp, said curing lamp curing with a wavelength of 365 nm and/or with a wavelength of 400 nm, with a UV dose of 8 J/cm^2 to 12 J/cm^2 and within a range of 20s to 100s.
- Preferably said coating composition is thermally curable. Thermally curable means that said coating composition is curable by the application of heat, preferably in an oven. Thermally curable means that said coating is preferably cured in a temperature range of from 90°C to below the glass transition temperature T_G of the lens substrate. Thermally curable further means that said coating is cured in a temperature range of from 95°C to 125°C, more preferably from 100°C to 120°C and most preferably from 105°C to 115°C, each preferably within a range 2h to 4h, further preferably within a range of 2.5h to 3.5h.
- Preferably said coating composition comprises at least one epoxide component and/or at least one (meth)acrylate component. Said at least one epoxide component may be selected from the group consisting of trimethylolpropane triglycidyl ether [CAS No. 30499-70-8], trimethylolethane triglycidyl ether, tris(4-hydroxyphenyl)methane triglycidyl ether [CAS No. 66072-38-6], 1,3-butandiol diglycidyl ether [CAS No. 3332-48-7], 1,4-butanediol diglycidyl ether [CAS No. 2425-79-8], poly(ethylene glycol) diglycidyl ether [average molecular weight 500, 2000, CAS No. 26403-72-5], poly(propylene glycol) diglycidyl ether [average molecular weight ~380, ~640, CAS No. 26142-30-3], neopentyl glycol diglycidyl ether [CAS No. 17557-23-2], 3,4-epoxycyclohexylmethyl 3,4-epoxycyclohexanecarboxylate [CAS No. 2386-87-0], bisphenol A diglycidyl ether [CAS No. 1675-54-3], triphenylolmethane triglycidyl ether [CAS No. 660272-38-6], trisphenol triglycidyl ether [CAS No. 66072-38-6], tetraphenylol ethane triglycidyl ether [CAS No. 37237-76-6], 1,2,6-hexanetriol triglycidyl ether [CAS No. 68959-23-9], glycerol triglycidyl ether [CAS No. 13236-02-7], 2-butyne-1,4-diol diglycerol ether [CAS No.68411-16-5], propoxylated glycerine triglycidyl ether [CAS No. 37237-76-6],ethylene glycol diglycidyl ether [CAS No. 2224-15-9], 1,4-butanediol diglycidyl ether [CAS No. 2425-79-8], neopentyl glycol diglycidyl ether [CAS No. 17557-23-2], cyclohexanedimethanol diglycidyl ether [CAS No. 14228-73-0], dipropylene glycol diglycidyl ether [CAS No. 28877-93-2], dibromoneopentyl glycol diglycidyl ether [CAS No. 29953-15-9] and 3,4-epoxycylohexylcarboxylat [CAS No. 2386-87-0]. Preferably, said at least one epoxide component is selected from the group

consisting of trimethylolpropane triglycidyl ether, trimethylolethane triglycidyl ether, tris(4-hydroxyphenyl)methane triglycidyl ether, triphenylolmethane triglycidyl ether, trisphenol triglycidyl ether, tetraphenylol ethane triglycidyl ether, 1,2,6-hexanetriol triglycidyl ether and glycerol triglycidyl ether. Further preferably, said at least one epoxide component is selected from the group consisting of trimethylolpropane triglycidyl ether, trimethylolethane triglycidyl ether and triphenylolmethane triglycidyl ether.

Said at least one (meth)acrylate component may be selected from the group consisting of pentaerythritol tetraacrylate [CAS No. 4986-89-4], trimethylolpropane triacrylate [CAS No. 15625-89-5], trimethylolpropane trimethacrylate [Cas No. 3290-92-4], dipentaerythritol penta-/hexa-acrylate [CAS No. 60506-81-2], 1,6-hexanedioldiacrylate [CAS No. 13048-33-4], tetramethylolmethane triacrylate, trimethylolpropanetriethylene glycol triacrylate, pentaerythritol tetramethacrylate, dipentaerythritol hexaacrylate, urethaneoligomer tetraacrylate, urethane oligomer hexamethacrylate, urethane oligomer hexaacrylate, polyester oligomer hexaacrylate, diethylene glycol dimethacrylate, tripropylene glycol dimethacrylate, tetraethylene glycol dimethacrylate, tripropylene glycol dimethacrylate, bisphenol A dimethacrylate, 2,2-bis(4-methacryloyloxyethoxyphenyl) propane, glycidyl methacrylate, 2,2-bis(4-acryloyloxypolyethylene glycol phenyl)propane, poly(ethylene glycol) methylether methacrylate [CAS No 36915-72-0]. Preferably, said at least one (meth)acrylate component is selected from the group consisting of pentaerythritol tetraacrylate, pentaerythritol tetramethacrylate, trimethylolpropane triacrylate, dipentaerythritol hexaacrylate and urethaneoligomer tetraacrylate. Further preferably, said at least one (meth)acrylate component is selected from the group consisting of pentaerythritol tetraacrylate, pentaerythritol tetramethacrylate and trimethylolpropane triacrylate.

In case said coating composition comprises at least one epoxide component and at least one (meth)acrylate component, the weight ratio between said at least one epoxide component and said at least one (meth)acrylate component preferably is in a range of epoxide component/ (meth)acrylate component from 0.64 to 4.3, further preferably from 0.7 to 4.1, more preferably from 0.8 to 4.0 and most preferably from 1.0 to 3.0. In case said coating composition comprises at least one epoxide component and at least one (meth)acrylate component in a weight ratio of epoxide component/ (meth)acrylate component preferably within one of the before mentioned ranges, said at least one epoxide component and said at least one (meth)acrylate component preferably is selected from the respective group mentioned before.

In case said coating composition comprises at least one epoxide component and at least one (meth)acrylate component, preferably the total amount

- of said at least one epoxide component is within a range of from 39% by weight to 81% by weight, further preferably from 45% by weight to 75% by weight, more preferably from 50% by weight to 70% by weight, and most preferably from 55% by weight to 65% by weight, and
- of said at least one (meth)acrylate component is within a range of from 19% by weight to 61% by weight, further preferably from 25% by weight to 55% by weight, more preferably from 30% by weight to 50% by weight, and most preferably from 35% by weight to 45% by weight,

each total amount being based on the total weight of the sum of said at least one epoxide component and said at least one (meth)acrylate component. With respect to said total weight of the sum, said total amount of said at least one epoxide component and said total amount of said at least one (meth)acrylate component are combined to add up to 100% by weight. The before mentioned ranges for said total amounts each apply to one single epoxide component or a mixture of different epoxide components as well as to one single (meth)acrylate component or a mixture of different (meth)acrylate components. In case said coating composition comprises at least one epoxide component and at least one (meth)acrylate component, preferably within one of said total amount ranges for said at least one epoxide component and said at least one (meth)acrylate component given before, said at least one epoxide component and said at least one (meth)acrylate component preferably is selected from the respective group mentioned before.

In case said coating composition comprises at least one epoxide component, i.e., in case said coating composition comprises said at least one epoxide component only and no additional (meth)acrylate component, said at least one epoxide component preferably is based on cationic-polymerizing epoxy resins such as the ones commercially available as DELO KATIOBOND series, company DELO, in particular the pressure sensitive epoxy-based adhesive DELO KATIOBOND PS6372.

In case said coating composition comprises at least one (meth)acrylate component, i.e., in case said coating composition comprises said at least one (meth)acrylate component only and no additional epoxide component, said at least one (meth)acrylate component preferably is based on modified acrylates such as the acrylate-based adhesives commercially available as DELO PHOTOBOND series, company DELO, in particular the pressure sensitive acrylate-based adhesive DELO PHOTOBOND PS4130.

- Preferably said coating composition comprising said at least one epoxide component and said at least one (meth)acrylate component comprises at least one catalyst. Said at least one catalyst may be selected from the group consisting of triarylsulfonium salts, preferable triarylsulfonium hexafluorophosphate, 50% in propylene carbonate [CAS No. 109037-77-6, company Sigma Aldrich]; alpha-amino acetophenones, for example 2-methyl-1-[4-phenyl]-2- morpholinopropan-1-one [CAS No. 71868-10-5, Irgacure 907], 2-benzyl-2-dimethyl amino-1-(4-morpholinophenyl)-butanone-1 [CAS No. 119313-12-1, Irgacure 369]; monoacyl and bisacyl phosphine oxides and sulphides, such as phenylbis(2,4,6-trimethylbenzoyl)-phosphine oxide [CAS No. 162881-26-7, Irgacure 819].

Preferably, said coating composition consisting of said at least one epoxide component, said at least one (meth)acrylate component and said at least one catalyst, each preferably being selected from the respective group mentioned before, comprises said at least one catalyst preferably in a total amount within a range of from 1% by weight to 4% by weight, further preferably from 1.5% by weight to 3.5% by weight, more preferably from 1.7% by weight to 3% by weight, and most preferably from 2% by weight to 2.7% by weight, each total amount being based on the total weight of said coating composition.

- Preferably said coating composition is compatible with different optical materials a lens substrate may be based on. Further preferably, said coating composition is compatible with common optical material of lens substrates, such as for example, 1.5 CR 39, 1.60 MR-8, 1.67 MR-7, 1.67 MR-10, 1.74 MR-174, 1.53 Trivex.

- Preferably said coating composition is compatible with various coating compositions applied to said coating composition.
- Said compatible means said coating composition presents sufficient wettability to said lens substrate to form a coating layer, said coating layer presents sufficient adhesion to said lens substrate, said coating layer does not present defects like bubbles, cracks and pinpoints because of unfavorable chemical reactions between said coating composition and said lens substrate.
- Optionally, said coating composition comprises at least one photochromic dye. Such a photochromic coating composition may comprise two or three photochromic dyes. The photochromic dye(s) can be combined so that, for example, by additive color mixing, any desired photochromic color can be produced. Preferably, the at least one photochromic dye is selected from the group consisting of naphthopyrans, spironaphthopyrans, oxazines, spironaphthoxazines, benzopyrans, spirobenzoxzines, spirobenzopyrans, spiropyrans, chromenes, fulgides, fulgimides, spirooxazines, organo-metal dithiozonates, triarylmethanes, stilbenes, azastilbenes, nitrones, quinones, and mixtures thereof. For instance, the photochromic dye(s) are selected from the group consisting of: 1,3-dihydrospiro[2H-anthra[2,3-d]imidazole-2,1'-cyclohexane]-5,10-dione; 1,3-dihydrospiro[2H-anthra[2,3-d]imidazole-2,1'-cyclohexane]-6,11-dione; 1,3-dihydro-4-(phenylthio)spiro[2H-anthra-1',2-diimidazole-2,1'-cyclohexane-6,11-dione; 1,3-dihydrospiro[2-H-anthra[1,2-d]imidazole-2,1'-cycloheptane]-6,11-dione-1,3,3-trimethylspiroindole-2,3'[3H]naphtho[2,1-b]-1,4-oxazine]2-methyl-3,3'-spiro-bi-[3H-naphtho[2,1-bipyran](2-Me); 2-phenyl-3-methyl-7-methoxy-8'-nitrospiro[4H]-1-benzopyran-4,3'-[3H]-naphtho[2,1-bipyran; spiro[2H-1-benzopyran-2,9'-xanthene]; 8-methoxy-1',3'-dimethylspiro(2H-1-benzopyran-2,2'-(1'H)-quinoline; 2,2'-spiro-bi-[2H-1-benzopyran]; 5'-amino-1',3',3'-trimethylspiro[2H-1-benzopyran-2,2'-indoline; ethyl-beta-methyl-beta-(3',3'-dimethyl-6-nitrospiro(2H-1-benzopyran-2,2'-indolin-1'-yl)-propenoate; (1,3-propanediyl)bis[3',3'-dimethyl-6-nitrospiro[2H-1-benzopyran-2,2'-indoline]; 3,3'-dimethyl-6-nitrospiro[2H-1-benzopyrao-2,2'-benzoxazoline]; 6'-methylthio-3,3'-dimethyl-8-methoxy-6-nitrospiro[2H-1-benzopyran-2,2'-benzothiozoline]; (1,2-ethanediyl)bis[8-methoxy-3-methyl-6-nitrospiro[2H-1-benzopyran-2,2'-benzothiozoline]; N-N'-bis(3,3'-dimethyl-6-nitrospiro[2H-1-benzopyran-2,2'(3'H)-benzothioazol-6'-yl)decanediamide]; alpha-(2,5-dimethyl-3-furyl)ethylidene(Z)-ethylidenesuccinicanhydride; alpha-(2,5-dimethyl-3-furyl)-alpha'-delta-dimethylfulgide; 2,5-diphenyl-4-(2'-chlorophenyl)imidazole; (2',4'-dinitrophenyl)methyl]-1H-benzimidazole; N-N-diethyl-2-phenyl-2H-phenanthro[9,10-d]imidazol-2-amine; 2-nitro-3-aminofluoren-2-amino-4-(2'-furanyl)-6H-1,3-thiazine-6-thione, and mixtures thereof. Additionally or alternatively to the before exemplarily mentioned, the photochromic dye(s) can be selected from the group consisting of: CNN11, CNN12, CNN13, CNN14, CNN15, CNN16, CNN17 (K.K. Tokuyama, Tokyo, Japan), Reversacol Midnight Gray, Reversacol Pacific Blue, Reversacol Sunflower, Reversacol Corn Yellow (James Robinson, Ltd., Huddersfield, England), and mixtures thereof.

Preferably, the photochromic dye(s) is/are present in an amount in a range of from 0.001 to 0.5 % by weight, preferably from 0.01 to 0.1 % by weight, based on the total weight of said photochromic coating composition. The before mentioned ranges shall apply irrespective if only one single photochromic dye is comprised in said photochromic coating composition or if a mixture of different photochromic dyes are comprised in said photochromic coating composition.

The coated lens comprises a lens substrate, the lens substrate at least having a front surface and a back surface. The lens substrate comprises on at least one surface thereof a coating composition, said coating composition being described before. The lens substrate comprises on the front surface and/or on the back surface said coating composition. Said coating composition on the front surface of the lens substrate comprises a surface facing away from the front surface of the lens substrate, at least said surface comprises a stamping. Said coating composition on the back surface of the lens substrate comprises a surface facing away from the back surface of the lens substrate, at least said surface comprises a stamping. Preferably, only said coating composition on the front surface of the lens substrate comprises a surface facing away from said front surface and at least said surface comprises a stamping.

For a coated lens comprising a lens substrate, said lens substrate at least having a front surface and a back surface, at least one of said front surface and said back surface being coated with a coating composition, said coating composition described before,

- said coating composition on the front surface comprises an outermost surface, i.e., a surface not being in contact with said front surface, said outermost surface being the outermost front surface of the coated lens,
- said coating composition on the back surface comprises an outermost surface, i.e., a surface not being in contact with said back surface, said outermost surface being the outermost back surface of the coated lens.

For said coated lens, said outermost surface comprises a stamping. In case, an additional coating or an additional coating composition is applied to said outermost surface, said additional coating or said additional coating composition again each comprises an outermost surface, i.e., a surface not being in contact with said outermost surface comprising said stamping, said outermost surface of said additional coating or said additional coating composition then is the outermost surface of the coated lens. Said outermost surface of said additional coating or said additional coating composition may

- adapt to said stamping, i.e., essentially maintain a structure of said stamping, or
- completely cover said stamping, i.e., essentially maintain a surface topography of said respective surface of said lens substrate.

The front surface is according to ISO 13666:2019(E), section 3.2.13, the surface of the lens intended to be fitted away from the eye. In the context of the present invention, the front surface of the lens substrate is defined analogously, the front surface of the lens substrate is the surface of the lens substrate intended to be fitted away from the eye. The back surface is according to ISO 13666:2019(E), section 3.2.14, the surface of the lens intended to be fitted nearer to the eye. In the context of the present invention, the back surface of the lens substrate is defined analogously, the back surface of the lens substrate is the surface of the lens substrate intended to be fitted nearer to the eye.

In the context of the present invention, a stamping shall mean at least one of the following:

- at least one protrusion on a coating composition, i.e., one protrusion or more protrusions on a coating composition,
- at least one protrusion protruding a surface of a coating composition, i.e., one protrusion or more protrusions protruding a surface of a coating composition, said surface facing away from a surface of a lens substrate comprising said coating composition, said surface being an outermost surface with respect to a surface of a lens substrate comprising said coating composition, said surface not being next or adjacent to a surface of a lens substrate comprising said coating,
- at least one protrusion on a coating, i.e., one protrusion or more protrusions on a coating,
- at least one protrusion protruding a surface of a coating, i.e., one protrusion or more protrusions protruding a surface of a coating, said surface of said coating facing away from a surface of a lens substrate comprising said coating, said surface being an outermost surface with respect to a surface of a lens comprising said coating, said surface not being next or adjacent to a surface of a lens substrate comprising said coating,
- at least one recess in a coating composition, i.e., one recess or more recesses in a coating composition,
- at least one recess in a surface of a coating composition, i.e., one recess or more recesses in a surface of a coating composition, said surface facing away from a surface of a lens substrate comprising said coating composition, said surface being an outermost surface with respect to a surface of a lens substrate comprising said coating composition, said surface not being next or adjacent to a surface of a lens substrate comprising said coating,
- at least one recess in a coating, i.e., one recess or more recesses in a coating,
- at least one recess in a surface of a coating, i.e., one recess or more recesses in a surface of a coating, preferably said surface facing away from a surface of a lens substrate comprising said coating, said surface being an outermost surface with respect to a surface of a lens substrate comprising said coating, said surface not being next or adjacent to a surface of a lens substrate comprising said coating,
- a deviation from a surface topography of a coating composition, said deviation deviating from a surface topography of a surface of a lens substrate comprising said coating composition,
- a deviation from a surface topography of a coating, said deviation deviating from a surface topography of a surface of a lens substrate comprising said coating.

Said protrusion or said recess each preferably has an equivalent tangential radius within a range of from 10mm to 300mm, further preferably from 30mm to 250mm, more preferably from 50mm to 200mm and most preferably from 70mm to 180mm.

Said equivalent tangential radius is measured by a white light interferometer, preferably a Bruker ContourGT-X in VXI measurement mode with the deduction of the surface curvature of said lens substrate.

Said protrusion preferably provides to a coating comprising said protrusion an additional power. Said protrusion further preferably provides in a domain of said protrusion an additional power to a front surface and/or a back surface of a coated lens comprising said protrusion with respect to the respective front surface or with respect to the respective back surface of the coated lens outside the domain of said protrusion. The domain of a stamping formed as protrusion is defined below. Said additional power preferably is selected from at least one the following ranges:

- said additional power (ADD) is within a range of larger than 3 dioptres and equal to or lower than 14 dioptres;
- said additional power (ADD) is within a range of larger than 5 dioptres and equal to or lower than 13 dioptres;
- said additional power (ADD) is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres.

Said recess preferably provides to a front surface and/or back surface of a coated lens comprising one coating or more coatings comprising said recess in a domain of said recess a difference in surface power with respect to a surface power of the respective front surface and/or the respective back surface outside the domain of said recess. The domain of a stamping formed as recess is defined below. The surface power is as defined in ISO 13666:2019(E), section 3.10.4 (surface power). Said difference in surface power preferably is selected from at least one the following ranges:

- said difference in surface power is within a range of larger than 3 dioptres and equal to or lower than 14 dioptres;
- said difference in surface power is within a range of larger than 5 dioptres and equal to or lower than 13 dioptres;
- said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres.

Said protrusion preferably causes a difference in focal length with respect to a surface comprising said protrusion. Said recess preferably causes a difference in focal length with respect to a surface comprising said recess.

Preferably, a stamping formed as protrusion or formed as recess causes in a domain of said stamping, i.e., in a domain of said protrusion or in a domain of said recess, a difference in surface power with respect to a surface power of a front surface of a coated lens comprising the stamping but outside the domain of the stamping and/or a difference in surface power with respect to a surface power of a back surface of a coated lens comprising the stamping outside the domain of the stamping.

Preferably, a stamping provides in a domain of said stamping a surface power to a lens surface of a coated lens which is different from a surface power of a lens surface, i.e., a front surface and/or a back surface, of the coated lens comprising a coating with said stamping but outside the domain of said stamping. Preferably, a difference in surface power is within at least one range selected from the following group of ranges:

- said difference in surface power is within a range of larger than 3 dioptres and equal to or lower than 14 dioptres;
- said difference in surface power is within a range of larger than 5 dioptres and equal to or lower than 13 dioptres;
- said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres.

Preferably, in case a stamping is forming one protrusion of a coated lens, said one protrusion comprises a surface topography selected from at least one of the following surfaces or pieced together from parts selected from at least one of the following surfaces:

- a spherical surface as defined in ISO 13666:2019(E), section 3.4.1;
- a part of a spherical surface;
- a cylindrical surface as defined in ISO 13666:2019(E), section 3.4.2;
- a part of a cylindrical surface;
- an aspherical surface as defined in ISO 13666:2019(E), section 3.4.3;
- a part of an aspherical surface;
- a toroidal surface as defined in ISO 13666:2019(E), section 3.4.6;
- a part of a toroidal surface;
- an atoroidal surface as defined in ISO 13666:2019(E), section 3.4.7;
- a part of an atoroidal surface;
- a power-variation surface as defined in ISO 13666:2019(E), section 3.4.10;
- a part of a power-variation surface.

In case a stamping is forming more protrusions of a coated lens, each of said more protrusions preferably comprises a surface topography selected from at least one surface or pieced together from parts of at least one surface mentioned before. Each of said more protrusions may comprise a surface topography selected from at least one of a same surface, may be pieced together from parts of a same surface, may comprise a different surface or may be pieced together from parts of different surfaces.

In case a stamping is forming one recess of one coating or more coatings of a coated lens, said one recess preferably is assumed to comprise a surface topography of a respective front surface and/or a respective back surface of a lens substrate to which said coating(s) is/are added to. In case a stamping is forming more recesses of one coating or more coatings of a coated lens, each of said more recesses are assumed to comprise a surface topography of a respective front surface and/or a respective back surface of a lens substrate to which said coating(s) is/are added to.

The stamping of a coated lens preferably comprises

- a domain on a front surface and/or on a back surface of a coated lens, said domain being part of one coating or more coatings added to said front surface and/or said back surface, said stamping preferably being the domain on said front surface, or

- a domain of a front surface and/or of a back surface of a coated lens, said domain being part of one coating or more coatings added to said front surface and/or said back surface, said stamping preferably being the domain of said front surface.

The stamping of the coated lens comprising the domain on the front surface and/or on the back surface preferably is formed as a protrusion, preferably as one protrusion or as more protrusions, which is/are part of one coating or more coatings added to a respective front surface and/or a respective back surface of a lens substrate, i.e., the stamping is elevated with respect to said one or more coating(s).

The stamping of the coated lens comprising the domain of the front surface and/or of the back surface preferably is formed as a recess, preferably as one recess or as more recesses, which is/are part of one coating or more coatings added to a respective front surface and/or respective back surface of a lens substrate, said one recess or said more recesses preferably being caused by said one coating or said more coatings, i.e., the one or more coating(s) is/are elevated with respect to the stamping.

Preferably, the stamping comprises a domain which is smaller than a respective front surface and/or a respective back surface of a coated lens comprising the stamping.

The stamping of the coated lens preferably comprises the domain which is limited by an onset line. Said onset line passes along each onset of said stamping. An onset of a stamping being formed as one protrusion or as one recess shall represent, preferably along a circumference or along a perimeter of said one protrusion or said one recess, a first position in which a surface topography of said one protrusion or said one recess deviated from a surface topography of the front surface and/or the back surface of the coated lens comprising said stamping. The domain of the stamping being formed as one protrusion or as one recess preferably is limited by one onset line only if within said domain a surface topography of said one protrusion or said one recess deviates in each discrete x,y,z position from a surface topography of the respective front surface and/or the respective back surface of the coated lens comprising said stamping, preferably outside said domain occupied by said stamping. The domain of the stamping being formed as one protrusion or as one recess may be limited by an outer onset line and an inner onset line. Said outer onset line passes along each outer onset of said stamping. Said inner onset line passes along each inner onset of said stamping. An outer onset shall represent, preferably along a circumference or along a perimeter of said one protrusion or said one recess, a first outer position in which a surface topography of said one protrusion or said one recess deviates from a surface topography of the front surface and/or the back surface of the coated lens comprising said stamping. An inner onset shall represent, preferably along a stamping-free domain of surrounded or encircled by a same stamping, a first inner position in which a surface topography of a same one protrusion or a same one recess deviated from a respective font surface and/or a respective back surface of a coated lens comprising said stamping. The domain of the stamping being formed as one protrusion or as one recess preferably is limited by an outer onset line and an inner onset line if within said domain a surface topography of said stamping is not deviating in each discrete x,y,z position from a surface topography of the respective front surface and/or the respective back surface of the coated lens comprising said stamping, preferably outside said domain comprising said stamping. In case the stamping is formed as more protrutions or as more recesses, the before given explanation with respect to the domain shall apply as well. Preferably, a surface normal at either an apex of a front surface of a coated lens or an apex of a back surface of a coated lens shall define an origin of a x,y,z coordinate system and a “z direction”. A “x,y direction” shall be in a tangential plane to either said front surface at the apex or said back surface at the apex. A x direction and a y direction shall be perpendicular to each other in said tangential plane.

Preferably, the stamping is having a surface power which is different to a surface power of at least one of

- a front surface of the coated lens comprising the stamping outside a domain occupied by the stamping,
- a back surface of the coated lens comprising the stamping outside a domain occupied by the stamping.

The surface power of the stamping is defined as in ISO 13666:2019(E), section 3.10.4 (surface power), as a local ability of a surface of the stamping to change the vergence of a bundle of rays incident at the surface. The surface power of the stamping preferably is as in note 1 to the entry ISO 13666:2019(E), section 3.10.4, determined from a radius or radii of the surface of the stamping and a refractive index (3.1.5) of a material of the stamping and is calculated for light (3.1.2) incident or emergent in air. The refractive index may be an actual refractive index of the material of the stamping or a nominal value. Preferably, the refractive index of the material of the stamping is assumed to be a same as a refractive index of an optical material of a lens substrate. Preferably, the refractive index of the material of the stamping is assumed to be the same as the refractive index of the optical material of the lens substrate, irrespective of whether the stamping a) is part of one or more coating(s) added to a front surface and/or a back surface of the lens substrate or b) is caused by said one or more coating(s).

The surface power each of the front surface and the back surface of the coated lens is defined as in ISO 13666.2019(E), section 3.10.4 (surface power), as local ability each of the front surface and the back surface of the coated lens to change the vergence of a bundle of rays incident at the surface. The surface power each of the front surface and the back surface is as in note 1 to the entry in ISO 13666:2019(E), section 3.10.4, determined from a radius or radii of the front surface or the back surface of a lens substrate and a refractive index (3.1.5) of an optical material (3.3.1) of the lens substrate, and is calculated for light (3.1.2) incident or emergent in air. The refractive index may be an actual refractive index of the optical material or a nominal value. The surface power of each of the front surface and the back surface of the lens substrate is assumed to be a same as the surface power of the respective front surface or the respective back surface of the coated lens not considering the stamping and not considering one or more coating(s) added to the front surface and/or back surface of the lens substrate.

In the context of the present invention, a stamping further shall mean any structure into which said coating composition described before is structureable or formable. Any structure exemplarily means structures such as

- one lenslet or a plurality of the lenslets as disclosed in WO 2020/180817 A1, each having a diameter of 0.5 mm or more up to 5 mm, or a lenslet having an add power of +0.25 D or more up to 5.0 D or an add power of -0.25 D or less, each compared to the based optical power of the lens;

- one optical element or a plurality of optical elements as disclosed in WO 2022/251713 A1, each having a desired shape and size;
- one light modulating cell or a plurality of the light modulating cells disclosed in WO 2020/261213 A1 having a dimension and power as disclosed therein, for example in [00108], [00118], [00121], or [00122];
- one island-shaped area or a plurality of the island-shaped areas disclosed in US 2017/0131567 A1, each having an area of about 0.50 to 3.14 mm^2, a circular shape of a diameter of about 0.8 to 2.0 mm and a distance between said island-shaped areas of equal to a value of a radius of diameter/2;
- one optical element or a plurality of the optical elements disclosed in WO 2019/166659 A1, each having a contour shape that is inscribable in a circle having a diameter greater than or equal to 0.8 mm and smaller than or equal to 3.0 mm, the more than one optical elements may be arranged contiguously as defined on page 15, line 27 to page 16, line 8 of WO 2019/166659 A1 or non-contiguously;
- one concentric ring or a plurality of the concentric rings disclosed in WO 2019/166659 A1, figure 11b, the concentric rings arranged spaced apart from each other;
- one cyclindrical microstructure or a plurality of the cylindrical microstructures disclosed in CN 111103701 A, each having a radial width of 0.5 mm to 2 mm, a distance between the different cylindrical microstructures is 0.5 mm to 3 mm;
- one ring-shaped focusing structure having a width of equal or lower than 0.7 mm or a plurality of the ring-shaped focusing structures disclosed in PCT/EP2022/053854, each having a width of equal or lower than 0.7 mm and a spectacle lens comprising said more than one ring-shaped focusing structure is characterized by a surface-based fill factor defined as a surface area ratio of the surface area of an innermost of said ring-shaped focusing structures and a sum of said surface area of said innermost ring-shaped focusing structures and an area of a peripheral clear zone being larger than 17 % and equal or lower than 70 % for said width in a range of 0.6 mm to 0.7 mm.

A stamping preferably structures or forms said coating composition described before in a ring-shaped structure. Said structure shall be considered as ring-shaped if it surrounds a structure-free zone and there is a path within the structure which runs from a starting point within the structure around the structure-free zone and to the starting point again.

In the context of the present invention, a stamping further shall mean at least one ring-shaped focusing structure. Said ring-shaped focusing structure preferably applies to structures providing a ring-shaped focal line as well as to structures comprising a plurality of lenslets adjoining each other such that they form a ring of contiguously connected lenslets and providing a plurality of foci along a ring-shaped line. The plurality of foci may be equidistantly arranged and preferably mainly line-shaped or point-shaped. At least one ring-shaped focusing structure means one ring-shaped focusing structure or more ring-shaped focusing structures.

A structure providing a ring-shaped focal line is for example shown in figures 14a and 14b and described in paragraph [0102] of EP 3 561 578 A1 or in figures 11a and 11b and described on page 20, lines 10 to 12, of WO 2019/166659 A1. Other variants of such structures providing a ring-shaped

focal line are disclosed in figure 1 of CN 111103701 A or in figures 5A and 5B of US 2019/0227342 A1.
In front view, i.e., if viewed perpendicular onto the front surface of the coated lens, ring-shaped does not necessarily need to be circular. Non-circular, elliptical, or otherwise curved ring-shaped as shown for example in figure 1 of CN 213659117 U is possible as well.
The lenslets do not necessarily to be circular lenslets if viewed in front view, i.e., if viewed perpendicular onto the front surface of the coated lens. For example, ring-shaped focusing structures comprising a plurality of lenslets adjoining each other may comprise structures like those described in WO 2019/166659 A1, page 17, line 25, to page 19, line 8 with reference to figure 1 shown therein.
In the context of the present invention, the term “lenslet” refers to a small convex structure in the approximately spherical, ellipsoidal, sinusoidal, or similar shape of a lens that is provided on a surface of a coated lens. This small convex structure has lateral dimensions that are several orders of magnitude smaller than the dimensions of the coated lens itself.
In case of the lenslets being small convex structures, lenslets are considered to adjoin each other in case there is a path between the centers of two lenslets that does not pass an area having solely the shape of the surface on which the lenslets are formed.
In the context of the present invention, the term “lenslet” refers to a small concave structure in the approximately spherical, ellipsoidal, sinusoidal, or similar shape of a lens that is provided in a surface of a coated lens. This small concave structure has lateral dimensions that are several orders of magnitude smaller than the dimensions of the coated lens itself.
In case of the lenslets being small concave structures, lenslets are considered to adjoin each other in case there is a path between the centers of two lenslets that does not pass an area having solely the shape of the surface on which the lenslets are formed.
Further details with respect to said ring-shaped focusing structure are given below in the context with the respective coated lens.

The coated lens comprises a lens substrate, the lens substrate being based on an optical material. The optical material, according to ISO 13666:2019(E), section 3.3.1, a transparent material capable of being manufactured into optical components, may be either a glass, a thermosetting hard resin or a thermoplastic hard resin. According to ISO 13666:2019(E), section 3.3.2, a glass, inorganic glass or mineral glass is a material formed by the fusion of inorganic substance, cooled down and solidified without crystallizing. According to ISO 13666:2019(E), section 3.3.3, a thermosetting hard resin is a plastic material, consisting principally of organic polymers, that has been cured into an essentially infusible and insoluble state, and cannot be usefully reshaped on heating. According to ISO 13666:2019(E), section 3.3.4, a thermoplastic hard resin is a plastic material consisting principally of organic polymers, that can be repeatedly softened by heating and hardened by cooling, and in the softened state can be shaped by flow into lenses or blanks by moulding, extrusion and forming.
Preferably, the lens substrate is based on a single optical material selected from the group consisting of a thermosetting hard resin and a thermoplastic hard resin.
The lens substrate may be
- clear according to the definition given in ISO 13666:2019(E), section 3.5.7, for a clear lens,

- absorptive according to the definition given in ISO 13666:2019(E), section 3.5.5, for an absorptive lens,
- tinted according to the definition given in ISO 13666:2019(E), section 3.5.6, for a tinted lens,
- photochromic according to the definition given in ISO 13666:2019(E), section 3.5.11, for a photochromic lens, or
- polarizing according to the definition given in ISO 13666:2019(E), section 3.5.12, for a polarizing lens.

Preferably, the lens substrate is clear, i.e., with no intended colour/tint in transmission.
Further, the lens substrate may be classified according to the state of manufacture as

- blank, the blank being defined in ISO 13666:2019(E), section 3.8.1, as piece of optical material with one optically finished surface for the making of a lens,
- single-vision blank, the single-vision blank being defined in ISO 13666:2019(E), section 3.8.2, as blank with the finished surface having a single nominal surface power,
- multifocal blank, the multifocal blank being defined in ISO 13666:2019(E), section 3.8.3, as blank with the finished surface having two or more visibly divided portions of different dioptric powers or focal powers,
- progressive-power blank, the progressive-power blank being defined in ISO 13666:2019(E), section 3.8.5, as power-variation blank where the finished surface is a progressive-power surface,
- degressive-power blank, the degressive-power blank being defined in ISO 13666:2019(E), section 3.8.6, as power-variation blank where the finished surface is a degressive-power surface,
- finished lens, the finished lens being defined in ISO 13666:2019(E), section 3.8.7, as lens of which both sides have their final optical surface,
- uncut lens, the uncut lens being defined in ISO 13666:2019(E), section 3.8.8, as finished lens prior to edging, or as
- edged lens, the edged lens being defined in ISO 13666:2019(E), section 3.8.9, as finished lens edged to final size and shape.

The lens substrate preferably is uncoated. If one of the before mentioned blanks shall comprise a coating composition or a coating, the respective final optical surface comprises said coating composition or said coating. If one of the before mentioned lenses shall comprise a coating composition or a coating, at least one side thereof comprises said coating composition or said coating.

Preferably, the lens substrate is a blank or an uncut lens.
Alternatively, in the lens substrate may be classified according to the form as afocal lens with nominally zero dioptric power according to ISO 13666:2019(E), section 3.6.3, or according to the function as corrective lens according to ISO 13666:2019(E), section 3.5.3, as a lens with dioptric power.
Alternatively, the lens substrate may be classified according to the type as

- single-vision lens according to ISO 13666:2019(E), section 3.7.1,
- position-specific single-vision lens according to ISO 13666:2019(E), section 3.7.2,
- multifocal lens according to ISO 13666:2019(E), section 3.7.3,
- bifocal lens according to ISO 13666:2019(E), section 3.7.4,

- trifocal lens according to ISO 13666:2019(E), section 3.7.5,
- fused multifocal lens according to ISO 13666:2019(E), section 3.7.6,
- power-variation lens according to ISO 13666:2019(E), section 3.7.7,
- progressive-power lens according to ISO 13666:2019(E), section 3.7.8, or as
- degressive-power lens according to ISO 13666:2019(E), section 3.7.9.

Preferably, the lens substrate is a single-vision lens, i.e., a lens designed to provide a single dioptric power.

In accordance with the different variants or classifications of the lens substrate given before, the front surface of the lens substrate and/or the back surface of the lens substrate each may have the surface topography of a(n)

- spherical surface according to ISO 13666:2019(E), section 3.4.1,
- cylindrical surface according to ISO 13666:2019(E), section 3.4.2,
- aspherical surface according to ISO 13666:2019(E), section 3.4.3,
- toroidal surface according to ISO 13666:2019(E), section 3.4.6,
- atoroidal surface according to ISO 13666:2019(E), section 3.4.7,
- power-variation surface according to ISO 13666:2019(E), section 3.4.10, or a
- meridionally-compensated aspherical surface according to ISO 13666:2019(E), section 3.4.11.

Preferably, at least said front surface is having the surface topography of a spherical surface, i.e., part of the inside or outside surface of a sphere.

Additionally to the before mentioned surface topographies for the front surface and/or the back surface of the lens substrate, the front surface of the lens substrate and/or the back surface of the lens substrate may comprise

- at least one protrusion preferably with projected diameter ranges from 0.2 mm to 2 mm, further preferably from 0.3 mm to 1.8 mm, more preferably form 0.4 mm to 1.5 mm and most preferably 0.5 mm to 1.4 mm,
- at least one recess with projected diameter ranges from 0.2 mm to 2 mm, further preferably from 0.3 mm to 1.8 mm, more preferably form 0.4 mm to 1.5 mm and most preferably 0.5 mm to 1.4 mm,
- at least one ring-shaped focusing structure, with tangential width of the ring ranges from 0.2 mm to 2 mm, further preferably from 0.3 mm to 1.8 mm, more preferably form 0.4 mm to 1.5 mm and most preferably 0.5 mm to 1.4 mm,

i.e., the front surface of the lens substrate and/or the back surface of the lens substrate may comprise

- one protrusion or more protrusions,
- one recess or more recesses,
- one ring-shaped focusing structure or more ring-shaped focusing structures.

Said equivalent projected diameter ranges and said tangential width, i.e., a width in tangential direction, each is measured by a white light interferometer, preferably a Bruker ContourGT-X in VXI measurement mode with the deduction of the surface curvature of said lens substrate.

Preferably, at least the front surface of the lens substrate may comprise at least one of said at least one protrusion, said at least one recess and said at least one ring-shaped focusing structure. Further preferably, only the front surface of the lens substrate may comprise at least one of said at least one protrusion, said at least one recess and said at least one ring-shaped focusing structure. The front surface and/or the back surface of the lens substrate may comprise said at least one ring-shaped focusing structure in form of at least one recess or in form of at least one protrusion. The front surface of the lens substrate may comprise said at least one ring-shaped focusing structure a) in form of at least one recess, b) in form of at least one protrusion or c) in form of at least one recess and at least one protrusion. The back surface of the lens substrate may comprise said at least one ring-shaped focusing structure a) in form of at least one recess, b) in form of at least one protrusion or c) in form of at least one recess and at least one protrusion. Preferably, at least the front surface of the lens substrate may comprise said at least one ring-shaped focusing structure a) in form of at least one recess, b) in form of at least one protrusion or c) in form of at least one recess and at least one protrusion. Further preferably, only the front surface of the lens substrate may comprise said at least one ring-shaped focusing structure a) in form of at least one recess, b) in form of at least one protrusion or c) in form of at least one recess and at least one protrusion. In case the front surface of the lens substrate and the back surface of the lens substrate are each comprising at least one protrusion, the dimensions of said at least one protrusion on the front surface and the dimensions of said at least one protrusion on the back surface, may be identical to or different from each other. In case the front surface of the lens substrate and the back surface of the lens substrate are each comprising at least one recess, the dimensions of said at least one recess on the front surface and the dimensions of said at least one recess on the back surface, may be identical to or different from each other. In case the front surface of the lens substrate and the back surface of the lens substrate are each comprising at least one ring-shaped focusing structure, the form of said at least one ring-shaped focusing structure on the front surface and the form of said at least one ring-shaped focusing structure on the back surface, preferably each with respect of said at least one ring-shaped focusing structure being formed as at least one recess and/or at least one protrusion, may be identical to or different from each other.

The surface of the lens substrate comprising said at least one protrusion provides in a domain of said at least one protrusion an additional power with respect to said surface outside the domain of said protrusion.

The surface of the lens substrate comprising said at least one recess provides in a domain of said lens substrate comprising said at least one recess a difference in surface power with respect to said surface outside the domain of said recess.

The surface of the lens substrate comprising said at least one ring-shaped focusing structure in form of said at least one recess provides due to said at least one recess to said surface of the lens substrate either at least one ring-shaped focal line or a plurality of foci along a ring-shaped line. Said plurality of foci may be equidistantly arranged and preferably mainly be line-shaped or point-shaped.

The surface of the lens substrate comprising said at least one ring-shaped focusing structure in form of said at least one protrusion provides due to said at least one protrusion to said surface of the lens substrate either at least one ring-shaped focal line or a plurality of foci along a ring-shaped line. Said plurality of foci may be equidistantly arranged and preferably mainly be line-shaped or point-shaped.

Said plurality of foci may be caused by a plurality of lenslets adjoining each other such that they form a ring of contiguously connected lenslets.

The surface of the lens substrate comprising said at least one ring-shaped focusing structure in form of said at least one recess and in form of said at least one protrusion may form said at least one recess and said at least one protrusion within the same ring-shaped focusing structure. Alternatively, the surface of the lens substrate comprising more ring-shaped focusing structures in form of said at least one recess and in form of said at least one protrusion may form said at least one recess in one ring-shaped focusing structure and said at least one protrusion in another ring-shaped focusing structure. Further alternatively, the surface of the lens substrate comprising more ring-shaped focusing structures in form of said at least one recess and in form of said at least one protrusion may form said at least one recess and said at least one protrusion in one ring-shaped focusing structure, and additionally may form said at least one protrusion in another ring-shaped focusing structure and/or said at least one recess again in another ring-shaped focusing structure. For said at least one recess and said at least one protrusion being formed within the same ring-shaped focusing structure, said at least one recess and said at least one protrusion each provides to said surface of the lens substrate either a ring-shaped focal line or a plurality of foci along a ring-shaped line. For said at least one recess being formed within the same ring-shaped focusing structure, said at least one recess provides either at least one focal line or a plurality of foci along a ring-shaped line to said surface of the lens substrate. For said at least one protrusion being formed within the same ring-shaped focusing structure, said at least one protrusion provides either at least one focal line or a plurality of foci along a ring-shaped line to said surface of the lens substrate. Said plurality of foci may be equidistantly arranged and preferably mainly be line-shaped or point-shaped. Said plurality of foci may be caused by a plurality of lenslets protruding said surface of the lens substrate and adjoining each other to form a ring of contiguously connected lenslets.

The surface of the lens substrate comprising said at least one recess comprises at least one coating composition. The surface of the lens substrate comprising said at least one protrusion comprises at least one coating composition. The surface of the lens substrate comprising said at least one ring-shaped focusing structure in form of said at least one recess and/or in form of said at least one protrusion preferably comprises at least one coating composition. The coating composition being next and directly adjacent to said surface of the lens substrate comprising said at least one recess or said at least one ring-shaped focusing structure in form of at least one recess preferably

- fills at least said at least one recess, preferably after said coating composition being cured, to obtain, preferably by the resulting coating, the surface topography the surface of the lens substrate would have had without said at least one recess and thus preferably not covering the residual of said surface of the lens substrate,
- is a first coating composition that fills at least said at least one recess, preferably after said first coating composition being cured, to obtain, preferably by the resulting first coating, the surface topography the surface of the lens substrate would have had without said at least one recess, thus preferably not covering the residual of said surface of the lens substrate, and a second coating composition different to the one filling said at least one recess covers, preferably completely, said surface of the lens substrate as well as said filled at least one recess, said second coating

composition resulting after cure in a second coating, said first and second coating preferably having a difference in their respective refractive index of at least 0.01, or

- fills said at least one recess and covers, preferably completely, said surface of the lens substrate, i.e., the surface obtained by filling said at least one recess to match the surface topography the surface of the lens substrate would have had without said at least one recess, and the residual of said surface of the lens substrate. After cure said coating composition results in a coating.

Further preferably, said coating composition being next and directly adjacent to said surface of the lens substrate comprising said at least one recess or said at least one ring-shaped focusing structure in form of at least one recess fills said at least one recess, after cure the resulting coating to match the surface topography of the surrounding lens substrate and completely coats the so obtained surface of said lens substrate.

Said at least one recess provides to the surface of the lens substrate comprising said recess a difference in surface power, as mentioned before. Said at least one ring-shaped focusing structure in form of said at least one recess provides to the surface of the lens substrate comprising said at least one ring-shaped focusing structure at least one ring-shaped focal line or a plurality of foci along a ring-shaped line.

The coating composition being next and directly adjacent to said surface of the lens substrate comprising said at least one protrusion or said at least one ring-shaped focusing structure in form of at least one protrusion preferably

- covers said surface of the lens substrate without covering said at least one protrusion,
- covers said at least one protrusion and, preferably completely, the residual of said surface of the lens substrate, the covered at least one protrusion remaining visible as at least one covered protrusion on the resulting covered surface of the lens substrate. After cure of said coating composition, said coated at least one protrusion provides in case of said
  - at least one protrusion an additional power to said coated surface of the lens substrate,
  - at least one ring-shaped focusing structure in form of at least one protrusion an additional power to said coated surface of the lens substrate and/or at least one focal line or a plurality of foci along a ring-shaped line to said coated surface of the lens substrate. Said plurality of foci may be equidistantly arranged and preferably mainly be line-shaped or point-shaped. Said plurality of foci may be caused by a plurality of coated lenslets adjoining each other such that they form a ring of contiguously connected coated lenslets, or
- covers said at least one protrusion and, preferably completely, covers the residual of said surface of the lens substrate, so that, after cure of said coating composition, the minimum thickness of the coating is greater than or equal to the maximum height of said at least one protrusion. The maximum height is the maximum dimension of a protrusion perpendicular to an imagined base surface of a lens substrate, said imagined base surface corresponds to the surface the lens substrate would have had without protrusion. Due to a difference in refractive index of at least 0.01 between said at least one protrusion and the coating surrounding and overcoating said at least one protrusion, said at least one protrusion provides
  - an additional power to said surface of the lens substrate comprising said protrusion,

- at least one ring-shaped focal line or a plurality of foci along a ring-shaped line to said surface of the lens substrate, in case of said ring-shaped focusing structure. Said plurality of foci may be equidistantly arranged and preferably mainly be line-shaped or point-shaped. Said plurality of foci may be caused by a plurality of lenslets adjoining each other such that they form a ring of contiguously connected lenslets.

Further preferably, said coating composition being next and directly adjacent to said surface of the lens substrate comprising said at least one protrusion or said at least one ring-shaped focusing structure in form of at least one protrusion covers said at least one protrusion, thus completely covering said surface of the lens substrate including said at least one protrusion. After cure, the resulting surface topography of the resulting coating is essentially the same as of the surface of the lens substrate without said at least one protrusion.

The lens substrate comprising at least one recess or at least one protrusion preferably is manufactured by methods selected from:

- Injection molding process with the thermoplastic material; for instance: polycarbonate, polyamide, polyolefins, polyethylene terephthalate, COP, COC material injected with an injection molding process, the injection mold has the recesses or protrusion structure.
- Casting process with thermosetting material; for instance: polythiourethane resin having a refractive index of 1.60 (MR8), or a polythiourethane resin having a refractive index of 1.67(MR7,MR10), or allyl-diglycol-carbonate resin have a refractive index of 1.499. A mold assembly is made by two glass molds or plastic molds, the mold has the recesses or protrusion structure; a gasket to hold the molds to create a cavity; fill in the resin into the cavity and apply thermal cure. Then detach the lens from the mold assembly.
- Laser engraving on a lens substrate to fabricate the recesses or protrusion
- Single point diamond tuning on a lens substrate to fabricate the recesses or protrusion.

The coated lens preferably comprises a coating, said coating being based on a composition as described before. Before cure, said coating composition is formed or structured, as described in detail below, to obtain a stamping. After cure, said coating composition results in a coating comprising said stamping. Preferably, at least the surface of said coating composition facing away from the surface of the lens substrate comprising said coating composition is formed or structured to comprise said stamping before cure. Cure transfers said coating composition in said coating. Preferably, at least the surface of said coating facing away from the surface of the lens substrate comprising said coating remains formed or structured to comprise said stamping after cure. Said stamping has been described before. After cure, said coating comprising said stamping preferably is characterized by at least one feature selected from the group consisting of:

- Preferably said coating has a thickness within a range of from 5 µm to 100 µm, further preferably from 10 µm to 90 µm, more preferably from 15 µm to 80 µm and most preferably from 20 µm to 60 µm. The thickness of said coating is determined by a chromatic confocal thickness measurement device, preferably the measurement device CHRocodile DPS, company PRECITEC.

- Preferably said coating has an indentation hardness within a range of from 50MPa to 600MPa, further preferably from 100MPa to 400MPa, more preferably from 150 MPa to 350MPa and most preferably from to 200MPa to 300MPa. The indentation hardness of said coating is preferably determined with the nanoindentation tester UNHT^3, company Anton Paar GmbH.
- Preferably said coating is durable by various designed tests that simulate extreme wearing conditions, said tests can be cross-cut adhesion, water boiling, QUV and other accelerated weathering tests.
- Preferably said coating is compatible with different optical materials a lens substrate may be based on, as already described before.
- Preferably said coating is compatible with various coating composition that may be applied to said coating.

Said coating being in a coating sequence of a coated lens next and adjacent to a lens substrate and in between said lens substrate and an additional outermost coating, thereby being compatible with both of them, means that said coating is easily accommodated to or placed into a given coating sequence. Easily accommodated to or placed into preferably means that said coating is just added into a given coating sequence without any need of changing said given coating sequence and/or without the need of adapting a directly adjacent coating composition to said coating.

Alternatively to said coating being next to and directly adjacent to the surface of the lens substrate comprising said coating, said coating may be next to but not directly adjacent to the lens substrate. In this alternative, at least one coating is in between said surface of the lens substrate and said coating. Preferably, said at least one coating in between is based on a coating composition as described before but having a different refractive index.

Said coating preferably is not the outermost coating of the coated lens. Said coating may optionally be coated with a primer coating. Said primer coating preferably is based on at least one primer coating composition comprising i) at least one aqueous aliphatic, cycloaliphatic, aromatic or heteroaromatic polyurethane dispersion, at least one aqueous aliphatic, cycloaliphatic, aromatic or heteroaromatic polyurea dispersion, at least one aqueous aliphatic, cycloaliphatic, aromatic or heteroaromatic polyurethane-polyurea dispersion and/or at least one aqueous aliphatic, cycloaliphatic, aromatic or heteroaromatic polyester dispersion, preferably at least one aqueous aliphatic polyurethane dispersion or at least one aqueous aliphatic polyester dispersion and more preferably at least one aqueous aliphatic polyurethane dispersion, and ii) at least one solvent, and iii) optionally at least one additive.

Said coating preferably is coated with a hard coating. Said hard coating, according to ISO 13666:2019(E), section 3.18.2, coating on the surface of an organic lens (3.5.2) intended to enhance the abrasion resistance of the surface during normal use, may be selected from at least one of the hard coatings disclosed in US 2005/0171231 A1, US 2009/0189303 A1, US 2002/0111390 A1, and EP 2 578 649 A1. Said hard coating preferably is either based on i) a hard coating composition comprising

A) a) at least one silane derivative of the formula (I) $Si(OR^1)(OR^2)(OR^3)(OR^4)$, wherein R^1, R^2, R^3 and R^4, which may be the same or different, are selected from an alkyl, an acyl, an alkyleneacyl, a cycloalkyl, an aryl or an alkylenearyl group, each of which may optionally be substituted, and/or
b) at least one hydrolysis product of the at least one silane derivative of the formula (I), and/or
c) at least one condensation product of the at least one silane derivative of the formula (I), and/or
d) any mixture of the components a) to c) thereof;
B) a) at least one silane derivative of the formula (II) $R^6R^7_{3-n}Si(OR^5)_n$, in which R^5 is selected from an alkyl, an acyl, an alkyleneacyl, a cycloalkyl, an aryl or an alkylenearyl group, each of which may optionally be substituted, R^6 is an organic radical containing at least one epoxide group, R^7 is selected from an alkyl, a cycloalkyl, an aryl or an alkylenearyl group, each of which may optionally be substituted, n is 2 or 3; and/or
b) at least one hydrolysis product of the at least one silane derivative of the formula (II), and/or
c) at least one condensation product of the at least one silane derivative of the formula (II), and/or
d) any mixture of the components a) to c) thereof;
C) at least one colloidal inorganic oxide, hydroxide, oxide hydrate, fluoride and/or oxyfluoride;
D) at least one epoxide compound having at least two epoxide groups; and
E) at least one catalyst system comprising at least one Lewis acid and at least one thermolatent Lewis acid-base adduct;
or ii) a hard coating composition comprising
A) a) at least one silane derivative of the formula (III) $R^1R^2_{3-n}Si(OR^3)_n$, wherein R^1 comprises an alkyl group, a cyclo alkyl group, an acyl group, an aryl group or a hetero aryl group, each of which may be substituted, R^2 is an organic rest comprising an epoxide group, R^3 comprises an alkyl group, a cyclo alkyl group, an aryl group or a hetero aryl group, each of which may be substituted, n = 2 or 3, and/or
b) at least one hydrolysis product of the silane derivative of the formula (III), and/or
c) at least one condensation product of the silane derivative of the formula (III), and/or
d) any mixture of components a) to c);
B) at least one colloidal inorganic oxide, hydroxide, oxide hydrate, fluoride and/or oxyfluoride;
C) at least one epoxy component comprising at least two epoxy groups; and
D) at least one catalyst system comprising at least one Lewis acid and at least one thermolatent Lewis base-adduct.

Preferably said stamping provides in a domain of said stamping an additional power to a front surface and/or a back surface of a coated lens comprising said additional coating, i.e, preferably said hard coating, with respect of said front surface and/or said back surface outside the domain of said stamping, said additional power being within at least one range selected from the following ranges:
- said additional power (ADD) is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
- said additional power (ADD) is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;

- said additional power (ADD) is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

Further preferably, said stamping provides in a domain of said stamping a surface power to a front surface and/or a back surface of a coated lens comprising said additional coating, i.e, preferably said hard coating, which is different to a surface power of said front surface and/or said back surface outside the domain of said stamping, a difference in surface power being within at least one range selected from the following ranges:
- said difference in surface power being within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
- said difference in surface power being within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;
- said difference in surface power being within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

Additionally, at least one of
- an anti-reflective coating
- an anti-reflective coating and a clean coating, the clean coating being the outermost thereof,
- an anti-reflective coating and an anti-fog coating, the anti-fog coating being the outermost thereof.

may be applied.

The coated lens according to the invention comprises core shell coating, said core shell coating comprising a stamping, said stamping as described before. Said stamping is having in a domain of said stamping a surface power which is different from a surface power of a lens surface, i.e., a front surface and/or a back surface, of the coated lens comprising said core shell coating outside said domain of said stamping. Preferably, a lens substrate, said lens substrate having at least a front surface and a back surface, comprises on at least one of said surfaces at least one core shell coating. Said lens substrate comprises on said front surface and/or on said back surface said at least one core shell coating. Said core shell coating on said front surface of the lens substrate comprises a surface facing away from said front surface of the lens substrate, at least said surface of the core shell coating comprises a stamping. Said core shell coating on said back surface of the lens substrate comprises a surface facing away from said back surface of the lens substrate, at least said surface of the core shell coating comprises a stamping. In a coated lens comprising a lens substrate and said core shell coating, the outermost surface of the shell of said core shell coating is with respect to the surface of the lens substrate comprising said core shell coating, the surface facing away from said surface of the lens substrate. In a coated lens comprising a lens substrate and said core shell coating only, the outermost surface of the shell of said core shell coating is simultaneously the outermost surface of such a coated lens, i.e., said outermost surface of the shell is the outermost surface of the coated lens if said coated lens comprises no further coating on top of said core shell coating. Said outermost surface of the shell is with respect to the surface of the lens substrate comprising said core shell coating said surface facing away from the lens substrate, but not necessarily the outermost surface of the coated lens. Said outermost surface of the shell is not the outermost surface of a coated lens if the coated lens comprises at least one additional coating on top of said core shell coating, i.e., on top of said surface of the shell facing away from the surface of the lens substrate comprising said core shell coating. Preferably at least said front surface of the lens substrate comprises said core shell coating, said core shell coating comprising a surface facing away from said front surface of the lens substrate, said surface comprising a stamping. Further preferably, only said front surface of the lens substrate comprises said core shell coating.

Said surface of the core shell coating facing away from the surface of the lens substrate comprising said core shell coating preferably is formed or structured to comprise said stamping. Preferably the shell and the core being directly adjacent to said shell are formed or structured to comprise said stamping.

The shell of said core shell coating preferably is not surrounding the core but said shell is at least directly adjacent to the surface of the core facing away from the surface of the lens substrate comprising said core shell coating. The shell of said core shell coating is covering the surface of the core not being next to the surface of the lens substrate comprising said core shell coating. The core of said core shell coating is next to and preferably directly adjacent to the surface of the lens substrate comprising said core shell coating. The core next to and directly adjacent to the surface of the lens substrate preferably adapts the surface topography of said surface of the lens substrate. Alternatively, the core of said core shell coating is next to but not directly adjacent to the surface of the lens substrate comprising said core shell coating. In this alternative at least one further coating is in between the surface of the lens substrate comprising said core shell coating and said core shell coating itself.

Preferably, the surface of the core not being next to the surface of the lens substrate, i.e., the surface of the core facing away from the surface of the lens substrate comprising the core shell coating, comprises said stamping. The shell being next and directly adjacent to said surface of the core comprising said stamping adapts said surface to also comprise said stamping.

The core shell coating may comprise with said stamping

- one structure that provides a ring-shaped focal line or a plurality of foci along a ring-shaped line to the shell, or
- more structures that provide a ring-shaped focal line or a plurality of foci along a ring-shaped line to the shell.

Said plurality of foci may be equidistantly arranged and preferably mainly line-shaped or point-shaped. Said plurality of foci preferably is caused by a plurality of lenslets adjoining each other to form a ring of contiguously connected lenslets.

The core of said core shell coating preferably comprises a coating composition as described before. The shell of said core shell coating preferably comprises a hard coating, for example one the hard coating as described before.

The coated lens comprises a lens substrate as described before.

Preferably, the core of said core shell coating provides a stamping, or completely covers recesses or protrusions of a substate, or both. The geometry of the stamping determines the optimized thickness range of said core. The shell of said core shell coating provides essential protection to said stamping and more importantly, act as a bridge layer between the core of said core shell coating and an adjacent coating, for example anti-reflective coating given the big difference in thermal expansion of them.

In case, the shell of a core shell coating being a hard coating as described before, said core shell coating comprising a thick core and a thin shell tend to have issues of crazing because of different thermal expansion; and vice versa, said core shell coating comprising a thin core and a thick shell limit the capability of realization of stampings, and also tend to have crazing because of the brittleness of the hard coating. Therefor to reduce the risk of crazing, preferably the shell of said core shell coating is having a thickness within a range of 0.6 µm to 10 µm, further preferably of 1.5 µm to 8 µm, more preferably of 2.0 µm to 7 µm and most preferably of 3 µm to 6 µm.

The coated lens according to the invention comprises a coating and/or an additional coating, said coating and/or said additional coating comprises a stamping, said stamping comprises at least one ring-shaped focusing structure, i.e., one ring-shaped focusing structure or more ring-shaped focusing structures. Preferably, said coated lens comprises a lens substrate as described before, said lens substrate having at least a front surface and a back surface. Said lens substrate comprises on at least one of said front surface and said back surface, at least one coating. Said at least one coating on said front surface of the lens substrate comprises a surface facing away from said front surface, at least said surface comprises a stamping comprising at least one ring-shaped focusing structure. Said at least one coating on said back surface of the lens substrate comprises a surface facing away from said back surface, at least said surface comprises a stamping comprising at least one ring-shaped focusing structure. Each of said at least one ring-shaped focusing structures have a respective width, and at least one additional feature selected from the group consisting of:

(i) a central clear zone having a central clear zone width within a range of 6 mm to 9.4 mm and said width being equal to or lower than 0.7 mm;
(ii) said width being lower than 0.5 mm;
(iii) a surface-based fill factor defined as a surface area ratio of a surface area of an innermost ring-shaped focusing structure of more ring-shaped focusing structures and a sum of said surface area of said innermost ring-shaped focusing structure of said more ring-shaped focusing structures and an area of a peripheral clear zone, said surface-based fill factor being within a range of larger than 17% and equal to or lower than 70% for said width of said more ring-shaped focusing structures in a range of 0.6 mm to 0.7 mm;
(iv) a surface-based fill factor defined as a surface area ratio of a surface area of an innermost ring-shaped focusing structure of more ring-shaped focusing structures and a sum of said surface area of said innermost ring-shaped focusing structure of said more ring-shaped focusing structures and an area of a peripheral clear zone, said surface-based fill factor being within a range of larger than 15% and equal to or lower than 60% for said width of said more ring-shaped focusing structures in a range of 0.5 mm to 0.6 mm;
(v) a surface-based fill factor defined as a surface area ratio of a surface area of an innermost ring-shaped focusing structure of more ring-shaped focusing structures and a sum of said surface area of said innermost ring-shaped focusing structure of said more ring-shaped focusing

structures and an area of a peripheral clear zone, said surface-based fill factor being within a range of larger than 6% and equal to or lower than 50% for said width of said more ring-shaped focusing structures lower than 0.5 mm.

The definitions and descriptions with respect to “coated lens”, “lens substrate”, “structure”, “ring-shaped focusing structure” given before shall apply.

The term “width of a ring-shaped focusing structure“ designates an expansion of a ring-shaped focusing structure along a direction perpendicular to its circumferential direction as measured from its inner and outer onsets. The term “onset” represents a first measurable position of a ring-shaped focusing structure on a surface of a coated lens. In other words, the term “onset” represents the position on the surface of the coated lens in which a surface shape, form or topography of the ring-shaped focusing structure starts to deviate from a shape, form or topography of the surface of the coated lens, the surface of the coated lens comprising the ring-shaped focusing structure, along the direction of the width; or, in case the surface of the coated lens comprising the ring-shaped focusing structure assumed to be of a same surface shape, form or topography as a surface of a lens substrate, the term “onset” represents a position on the surface of the coated lens in which a surface shape, form or topography of the ring-shaped focusing structure starts to deviate from a shape, form or topography of the surface of the lens substrate. Further, the term “inner onset” specifies an onset on the side of the ring-shaped focusing structure towards a center of the coated lens and the term “outer onset” specifies an onset of the ring-shaped focusing structure away from the center of the coated lens towards a periphery.

In the context of the present invention, the term “clear zone” applies to a structure-free zone of a coated lens. It is designed such that it shall neither provide a myopic defocus nor a diffusion in foveal vision when a wearer looks through the clear zone with the coated lens being positioned according a specified as-worn position. Furthermore, a clear zone may allow for achieving, if required assisted by accommodation, a focused image on the fovea.

A “central clear zone” is a structure-free zone which is neighbored and surrounded by a ring-shaped focusing structure.

The optical center (ISO 13666:2019(E), section 3.2.15) of a single-vision coated lens in general preferably is located within the central clear zone. Progressive-power coated spectacle lenses may comprise more than one, in particular two central clear zones located e.g., in near portion (ISO 13666:2019, section 3.15.3) and distance portion (ISO 13666:2019, section 3.15.1).

A “central clear zone width” is a maximum expansion of a domain of a central clear zone on a lens surface of a coated lens, i.e., a front surface or a back surface thereof, limited by two inner onsets of an innermost ring-shaped focusing structure in opposite tangential directions. Alternatively, a central clear zone width is a maximum expansion of a domain of a central clear zone on a lens surface of coated lens, limited by two inner onsets of an innermost ring-shaped focusing structure along each line through an optical centre or a fitting point of a coated lens. A fitting point of a coated lens is defined analogously as in ISO 13666:2019(E), section 3.2.34, as a point of the front surface of a coated lens stipulated by the manufacturer for positioning the coated lens in front of the eye.

A central clear zone with a central clear zone width within a range of 6 mm to 9.4 mm has the advantage that a small clear zone e.g., 6 mm increases the probable efficacy of the coated lens for a reduction of progression of myopia for a wearer. At the same time said small clear zone decreases the acceptance of the coated lens by the wearer due to the decreased comfort of wearability of the coated lens. A large clear zone e.g., 9.4 mm decreases the probable efficacy of the coated lens for the reduction of progression of myopia for the wearer. At the same time said large clear zone increases the acceptance of the coated lens by the wearer due to the increased comfort of wearability of the coated lens.

The term “fill factor” must be subdivided into “length-based fill factor” and “surface-based fill factor”. The length-based fill factor is used for determining the fill factor of a circular-shaped focusing structure, whereas the surface-based fill factor is used for determining the fill factor of a ring-shaped focusing structure.

The length-based fill factor is defined as the ratio of the width of the inner circular-shaped focusing structure adjacent to a clear zone (“width”) and the radial distance between the inner circular-shaped focusing structure and the neighboring circular-shaped focusing structure ("pitch"):

$$\text{length based fill factor} = \frac{\text{width}}{\text{pitch}}$$

A “pitch” is a distance between an onset of two neighboring circular-shaped focusing structures. The length-based fill-factor has the advantage to define the balance between the wearability and the manufacturing of the inventive coated lens comprising circular-shaped focusing structures. A length-based fill factor greater than 60 % results in a decrease of comfortable wearability of the coated lens but increases the probable efficacy of the coated lens for the reduction of progression of myopia for the wearer. A length-based fill factor smaller than 40 % results in a decrease of the probable efficacy of the coated lens for the reduction of progression of myopia for the wearer but increases the comfortable wearability of the coated lens. In other words, a well-defined balance between the wearability and the manufacturing of the inventive coated lens is achieved with a length-based fill factor in the range of 40 % to 60 %. In particular, a length-based fill factor of 50 % is preferred.

The “surface-based fill factor” is determined by a surface area ratio of a surface area of the innermost ring-shaped focusing structure of more ring-shaped focusing structures and a sum of said surface area of said innermost ring-shaped focusing structure and a surface area of a peripheral clear zone. The term “innermost” describes the closest ring-shaped focusing structure to the central clear zone. The term “peripheral clear zone” refers to the first clear zone next to central clear zone. In case a lens surface of a coated lens, i.e., a front surface and/or a back surface thereof, comprises one ring-shaped focusing structure, a peripheral clear zone is additionally to a central clear zone a further domain on a respective lens surface not comprising one or more ring-shaped focusing structure(s). Said one ring-shaped focusing structure is separating said central clear zone from said peripheral clear zone. In case said lens surface of said coated lens comprises said one ring-shapes focusing structure said peripheral zone expands from an outer onset line of said ring-shaped focusing structure to an edge of said lens surface. The outer onset line passes along each outer onset of said one ring-shaped focusing structure, the outer onset line is thereby surrounded or encircled by said peripheral clear zone. In this context shall be understood that an inner onset line is an onset line that preferably is closer to a central clear zone and an outer onset line preferably is further away from the central clear zone.

In case a lens surface of a coated lens, i.e., a front surface or a back surface thereof, comprises more ring-shaped focusing structures, a peripheral clear zone is additionally to a central clear zone a further domain on a respective lens surface not comprising one or more ring-shaped focusing structure(s). In this case, the peripheral clear zone is the further domain not comprising one or more ring-shaped focusing structure(s) closest to a central clear zone and separated from the central clear zone by an innermost ring-shaped focusing structure of said more ring-shaped focusing structures. In case said lens surface of said coated lens comprises said more ring-shaped focusing structures said peripheral clear zone expands from an outer onset line of said innermost ring-shaped focusing structure to an inner onset line of a closest neighboring ring-shaped focusing structure of said more ring-shaped focusing structures. The outer onset line passes along each outer onset of said innermost ring-shaped focusing structure and is thereby surrounded by said peripheral clear zone. The inner onset line passes along each inner onset of said closest neighboring ring-shaped focusing structure, the inner onset line is thereby limiting an expansion of said peripheral zone.

The surface area of an innermost ring-shaped focusing structure is determined by an inner onset line and an outer onset line of said innermost ring-shaped focusing structure. The inner onset line passes along each inner onset of the innermost ring-shaped focusing structure, said inner onset line is thereby surrounding or encircling a central clear zone. The outer onset line passes along each outer onset of the innermost ring-shaped focusing structure, said outer onset line is thereby surrounded or encircled by a peripheral clear zone. The inner onset line and the outer onset line of the innermost ring-shaped focusing structure are enclosing a surface area along a lens surface, i.e., a front surface or a back surface, of a coated lens without structure(s), said surface area is the surface area of the innermost ring-shaped focusing structure.

In case a lens surface of a coated lens, i.e., a front surface and/or a back surface thereof, comprises more ring-shaped focusing structures, the surface area of the peripheral clear zone is determined by an outer onset line of the innermost ring-shaped focusing structure and an inner onset line of a closest neighboring ring-shaped focusing structure. The inner onset line of the closest neighboring ring-shaped focusing structure passes along each inner onset of the closest neighboring ring-shaped focusing structure, said inner onset line thereby surrounding or encircling the peripheral clear zone. The outer onset line of the innermost ring-shaped focusing structure and the inner onset line of the closest neighboring at least one ring-shaped focusing structure are enclosing a surface area along a surface of the coated lens comprising said more ring-shaped focusing structures, said surface area is the surface area of the peripheral clear zone.

The surface-based fill-factor has the advantage to define a balance between wearability and manufacturing of a coated lens comprising more ring-shaped focusing structures. A surface-based fill factor greater than 59.2% results in a decrease of comfortable wearability of the coated lens but increases the probable efficacy of the coated lens for the reduction of progression of myopia for the wearer. A surface-based fill factor smaller than 56.1% results in a decrease of the probable efficacy of the coated lens for the reduction of progression of myopia for the wearer but increases the comfortable wearability of the coated lens. In other words, a well-defined balance between the wearability and the manufacturing of the inventive coated lens is achieved with a surface-based fill factor in the range of 34.6-59.2%. In particular, a surface-based fill factor of 46.4 to 47.7% is preferred.

Preferably said stamping of said coating is further characterized in that said width(s) of said at least one ring-shaped focusing structure is within at least one range selected from the following group of ranges:

(i) said width is larger than 0.2 mm and equal or lower than 0.7 mm;
(ii) said width is larger than 0.3 mm and equal or lower than 0.7 mm;
(iii) said width is equal or lower than 0.6 mm;
(iv) said width is larger than 0.2 mm and equal or lower than 0.6 mm;
(v) said width is larger than 0.3 mm and equal or lower than 0.6 mm;
(vi) said width is equal or lower than 0.5 mm;
(vii) said width is larger than 0.2 mm and equal or lower than 0.5 mm;
(viii) said width is larger than 0.3 mm and equal or lower than 0.5 mm.

The advantage consists in a well-defined balance between the wearability and the manufacturing of the coated lens. A decrease of the width of a ring-shaped focusing structure leads to a more comfortable wearability of the coated lens. An increase of the width of a ring-shaped focusing structure enables easier manufacturing of the coated lens.

Preferably said coated lens is further characterized in having a central clear zone width within at least one range selected from the following group of ranges:

(i) said central clear zone width is larger than 6 mm and lower or equal than 7 mm;
(ii) said central clear zone width is larger than 7 mm and lower or equal than 9.4 mm.

A central clear zone with a central clear zone width within a range of 6 mm to 7 mm has the advantage that a small clear zone e.g., 6 mm increases the probable efficacy of the coated lens for the reduction of progression of myopia for the wearer. At the same time said small clear zone decreases the acceptance of the coated lens by the wearer due to the decreased comfort of wearability of the coated lens. A central clear zone with a central clear zone width within a range of 7 mm to 9.4 mm has the advantage that a large clear zone e.g., 9.4 mm increases the acceptance of the coated lens by the wearer due to the increased comfort of wearability of the coated lens.

Preferably said coated lens is characterized in that said at least one ring-shaped focusing structure provide an additional power as compared to said central clear zone within at least one range selected from the following group of ranges:

(i) said additional power is larger than 6 diopter and equal or lower than 12 diopter;
(ii) said additional power is larger than 7 diopter and equal or lower than 11 diopter;
(iii) said additional power is larger than 8 diopter and equal or lower than 10 diopter.

In the context of the present specification, the term “additional power” applies to a focal power that is added to the focal power of a coated lens in at least one meridian, where the focal power of a coated lens provides, assisted by accommodation, a focused image on the fovea and the additional power, when added to the focal power of a coated lens, provides for a myopic defocus. The additional power must not be confused with the addition power of a progressive addition lens.

The term “focal power” is a collective term for the spherical vertex power, which brings a paraxial pencil of parallel light to a single focus (and which is usually considered in the prescription by the “sphere” value or, abbreviated, “sph”, and the cylindrical vertex power of a spectacle lens, which brings a paraxial pencil of parallel light to two separate line foci mutually at right angles (ISO 13666:2019(E), section 3.10.2) and which is usually considered in the prescription by the “cylinder” value or, abbreviated, “cyl”. The advantage of this further advantageous embodiment is to define the balance between the wearability and the manufacturing of the coated lens. An additional power between 10 and 12 diopter increases the probable efficacy of the coated lens for the reduction of progression of myopia for the wearer. An additional power between 6 and 8 diopter increases the comfortable wearability of the coated lens. In other words, a well-defined balance between the wearability and the manufacturing of the coated lens is achieved with an additional power in the range of 6 diopter to 8 diopter. In particular an additional power of 10 diopter is preferred.

A coated lens described before may be available in physical reality or as a digital twin of a coated lens, the digital twin of the coated lens being for the purpose of a use of the digital twin for a manufacture of the coated lens. The digital twin of a coated lens shall be defined analogously as in ISO 13666:2019(E), section 3.18.1 (coated lens), as a digital twin of a spectacle lens to which one or more surface layers have been added digitally to alter one or more properties of the digital twin of the spectacle lens. The digital twin of the coated lens is for the purpose of a use of the digital twin for manufacturing the coated lens. The digital twin of the coated lens is a mathematical description of a lens surface of a front surface of the coated lens, a mathematical description of a lens surface of a back surface of the coated lens, said mathematical descriptions including a relative orientation of the lens surface of the front surface to the lens surface of the back surface and a refractive index of a digital twin of a lens substrate.
The digital twin of the coated lens being for the purpose of a use for manufacturing the coated lens may be stored on a computer-readable data carrier or transformed into a data carrier signal.

The coated lens according to the present invention may be in the form of computer-readable instructions for the production thereof stored on a computer-readable data carrier.

The coated lens being designed according to the inventive principle described before may also be realized in the form of computer-readable data stored on a computer-readable data carrier.

The coated lens according to the present invention may be in the form of computer-readable instructions for the production thereof transformed into a data carrier signal.

The coated lens being designed according to the inventive principle described before may also be realized in the form of a data carrier signal.

The coated lens according to the present invention may be in the form of a numerical data set.

The coated lens according to the present invention may be in the form of a data signal transferring a numerical data set.

The coated lens according to the present invention may be in the form of a data carrier storing a numerical data set.

According to the invention, a method for manufacturing a coated lens comprises at least the following step of

- stamping a coating composition.

Said coating composition is a coating composition as described in detail before. The stamping, preferably the structure obtained by stamping said coating composition in form of at least one protrusion and/or at least one recess has been described before.

The method for manufacturing the coated lens is characterized in a step of

- stamping a coating composition such that a surface power in a domain of a stamping is different from a surface power of a lens surface comprising said coating composition outside said domain of said stamping.

Stamping said coating composition has at least one of the following advantages compared to WO 2020/078964 A1, on which the invention is based:

- No bubble and curing issues during curing in contrast to WO 2020/078964 A1. All hard coating compositions cited in WO 2020/078964 A1 are solvent based hard coating compositions, stamping such hard coating compositions results in issues like slow speed of curing and bubbles because of the unescapable solvent constrained by the laminated lens substrate and stamp,
- No limitation on geometry of stamping structure of said coating composition in contrast to WO 2020/078964 A1. Stamping a hard coating has a limitation on the compressibility thereof (normally <10% for volume, means <3% for thickness, C. E. Weir, Journal of Research of the National Bureau of Standards, Vol. 46, No. 3, March 1951, page 207-212; R.W. Warfield, Compressibility of Bulk Polymers, Polymer Engineering and Science, Volume 6 (2) – Apr 1, 1966, page 176-180),
- No temporarily stamping of said coating composition in contrast to WO 2020/078964 A1. Stamping a hard coating under high temperature and pressure will be only temporally as crosslinked coating composition will tend to recover its original shape given the elastic nature,
- No deformation of a lens substrate, even when based on a plastic material, in contrast to WO 2020/078964 A1. Stamping a hard coating under high temperature and pressure will not allow for selectively stamping the hard coating without deforming a lens substrate based on a plastic material.
- No crazing of said coating composition and after cure in the resulting coating in contrast to WO 2020/078964 A1. Stamping with high deformation, high temperature and high pressure a brittle hard coating results in crazing of the hard coating.

Stamping a coating composition shall mean that in contrast to US 2021/0263194 A1 a coating composition is already applied to a lens surface of a lens substrate, i.e., a front surface and/or a back surface thereof and then stamped and transferred via a stamp to a lens surface. As described below, at least one of a coating composition or a coating may be transferred via a stamp to an already existing coating composition of a lens surface of a lens substrate, i.e., to an already present coating composition on a front surface and/or a back surface thereof, while simultaneously stamping the already the already existing coating composition. Thus, in contrast to US 2021/0263194 A1, both the transferred coating composition and the already present coating composition or both the transferred coating and the already present coating composition comprise a stamping and not only the transferred coating composition or the transferred coating.

Preferably, a stamping provides in a domain of said stamping a surface power to a lens surface, i.e., a front surface and/or a back surface of a coated lens, comprising said stamping which is different to a surface power of said lens surface outside said domain of said stamping. Preferably, a difference in surface power being within at least one range selected from the following ranges:

- said difference in surface power is within a range of larger than 3 dioptres and equal to or lower than 14 dioptres;
- said difference in surface power is within a range of larger than 5 dioptres and equal to or lower than 13 dioptres;
- said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres.

Preferably, said stamping provides, after cure of said coating composition resulting in a coating, an additional power to said coating, said additional power being within at least one range selected from the following ranges:

- said additional power (ADD) is within a range of larger than 3 dioptres and equal to or lower than 14 dioptres;
- said additional power (ADD) is within a range of larger than 5 dioptres and equal to or lower than 13 dioptres;
- said additional power (ADD) is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres.

Preferably, in a domain of a stamping a surface power is different to a surface power of a lens surface comprising an additional coating outside said domain of said stamping, a difference in surface power preferably is within at least one range selected from the following ranges:

- said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
- said difference in surface power is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;
- said difference in surface power is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

Preferably, an additional coating composition is applied to said coating, said additional coating composition being an outermost coating composition and being selected from the group consisting of

- a hard coating composition,
- said coating composition, preferably having difference in refractive index of at least 0.01 to said coating
- said coating composition and a hard coating composition, the hard coating composition being the outermost thereof.

Applying an additional coating composition, for example a hard coating composition resulting after cure in a hard coating, has the advantage of having an outermost coating for the protection of said coating, and at least one of
- an anti-reflective coating
- an anti-reflective coating and an anti-fog coating, the anti-fog coating being the outermost thereof,
- an anti-reflective coating and a clean coating, the clean coating being the outermost thereof

may be applied to obtain a coated lens of high quality.

Preferably, said additional coating adapts to said coating.

Preferably, said stamping provides an additional power to said additional coating, said additional power being within at least one range selected from the following ranges:
- said additional power (ADD) is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
- said additional power (ADD) is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;
- said additional power (ADD) is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

Preferably, the method comprises at least the following steps in the given order:

(a) applying a coating composition to at least one of
  - a front surface of said lens substrate,
  - a back surface of said lens substrate,

(b) applying a surface of a stamp to at least one of
  - said front surface comprising said coating composition, and
  - said back surface comprising said coating composition,

  thereby stamping said coating composition between at least one of
  - said front surface and said surface of said stamp, and
  - said back surface and said surface of said stamp,

or

(a') applying a coating composition to a surface of a stamp,

(b') applying at least one of a front surface of said lens substrate and a back surface of said lens substrate to said surface of said stamp comprising said coating composition,

  thereby stamping said coating composition between at least one of
  - said front surface and said surface of said stamp,
  - said back surface and said surface of said stamp,

(c), (c') precuring said coating composition resulting in a precured coating,
(d), (d') removing said stamp from said precured coating,
(e), (e') curing said precured coating resulting in a coating, said coating comprising a stamping.

The thickness of the coating can be influenced by:

a) the geometry of the stamping
b) the viscosity of the coating composition
c) the total load (weight of stamp/lens and extra press force) and the time
d) the difference in surface curvature between the lens substrate and the stamp.

The surface area to be covered by the coating composition is influenced by:

a) the volume of coating composition
b) the total load and the time
c) the viscosity of the coating composition
d) the base curve of the surface, the steeper the more difficult to cover large area.

From process point of view, once the geometry of the stamping is determined, the next is to define an optimized coating thickness, and playing with "viscosity", "weight load and time", "volume of coating composition" to achieve it.

The stamp or at least the surface of the stamp being structured or formed to provide a stamping to an adjacent surface of a coating preferably is based on a material of high thermal stability, high UV durability and high transparency. The surface of the stamp should present characteristics of low water uptake, solvent resistance and low chemical reactivity for easy removal of the stamp from the adjacent surface of the coating composition said previously. The stamp can be any type of material that can be formed with a low surface roughness (Ra < 1µm), preferably the stamp is a kind of plastic that is optically transparent.

The stamp component can be either thermoset or thermoplastic, for thermoset preferably the stamp is produced by a casting and molding process, for thermoplastic preferably the stamp is produced by an injection molding process.

For a stamp that provides a stamping, the structure of said stamping can be created from the casting or injection process from the molds. Or separately by an additional process, i.e., laser engraving and single-point diamond machining.

The stamp produced from above process is preferably has no residual chemical functional groups like C=C, -COOH, -OH, $-CONH_2$, -SH, -CO-, -COH, $-SO_3H$, $-NH_2$.

The stamp is preferably having a water uptake in a range from 0 to 0.5%, more preferably in a range from 0 to 0.1%, mostly preferably in a range from 0% to 0.01%.

The stamp preferably has a high transmission in the UV wavelength described previously, more preferably having a transmission higher than 50%, most preferably higher than 80%.

For example, the stamp or at least the surface of the stamp being structured or formed may be based cyclic block copolymers such as commercially available as ViviOn (CBC), company USI Corporation.

According to the invention, a method for manufacturing a coated lens comprises at least the following step of

- stamping a first coating composition, thereby transferring at least one of a second coating composition and a second coating to said first coating composition.

The method for manufacturing a coated lens is characterized in a step of

- stamping a first coating composition, thereby transferring at least one of a second coating composition and a second coating to said first coating composition, such as in a domain of a stamping a surface power is different from a surface power of a lens surface comprising said first coating composition and at least one of said second coating composition and said second coating outside said domain of said stamping.

Preferably, a difference in surface power is selected from at least one range of the following group of ranges:

- said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
- said difference in surface power is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;
- said difference in surface power is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

The method for manufacturing a coated lens is characterized in a step of

- stamping a first coating composition, thereby transferring at least one of a second coating composition and a second coating to said first coating composition, such as a stamping comprises one ring-shaped structure or more ring-shaped structures.

Domain, surface power and ring-shaped structure preferably as described before.

With respect to the first coating composition the before given description with respect to a coating composition shall apply. With respect to the method stamping and the resulting stamping of a coating composition the before mentioned shall apply. The second coating preferably is a hard coating.

Preferably, in that in a domain of a stamping said stamping provides a surface power to a lens surface, i.e., a front surface and/or a back surface of a coated lens, comprising said second coating, preferably a hard coating, which is different to a surface power of said lens surface outside said domain of said stamping, a difference in surface power preferably being within at least one range selected from the following ranges:

- said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
- said difference in surface power is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;

- said difference in surface power is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

As mentioned before at least one of

- an anti-reflective coating
- an anti-reflective coating and an anti-fog coating, the anti-fog coating being the outermost thereof,
- an anti-reflective coating and a clean coating, the clean coating being the outermost therof,

may be further applied or deposited thereon.

Preferably, the method comprising at least the following steps:

(a) applying said first coating composition on at least of
 - a front surface of said lens substrate,
 - a back surface of said lens substrate,

(b) applying a stamp comprising another coating on at least one of
 - said front surface comprising said first coating composition,
 - said back surface comprising said first coating composition,
 thereby stamping said coating composition and transferring said other coating to said coating composition,

or

(a’) applying said first coating composition on a surface of a stamp, said surface of said stamp comprising another coating,

(b’) applying at least one of a front surface of said lens substrate and a back surface of said lens substrate to said surface of said stamp comprising said second coating composition or said second coating,
 thereby stamping said coating composition and transferring said second coating composition or said second coating to said first coating composition,

(c) (c’) curing said first and second coating compositions resulting in a first and second coating,

(d) (d’) removing said stamp from said second coating.

In the Figures:
Figure 1 shows a single vision coated lens according to an embodiment of the present invention with a plurality of ring-shaped focusing structures.
Figure 2 shows a cross-sectional view of the single vision coated lens according to Figure 1 to demonstrate how to determine the width of a ring-shaped focusing structure, the pitch of two neighboring ring-shaped focusing structures and the central clear zone width.
Figure 3 shows a cross section of a cross section of a coated lens according to example 19 of the present invention, with 1 being a lens substrate, 2 being a coating based on a coating composition comprising an epoxide component and an acrylate component, 3 being a hard coating, the anti-reflective coating and the clean coating not shown.

An exemplary embodiment of the present invention is described with respect to figure 1 and figure 2 which show a single vision coated lens 100. The single vision coated lens 100 comprises a central clear zone 110. The central clear zone 110 in this embodiment has a focal power being designed for the correction of an existing myopia of the wearer. In the present exemplary embodiment, the single vision coated lens 100 comprises additionally five circular-shaped focusing structures 101 to 105 of equal cross-section. Circular-shaped means ring-shaped with a circular contour in front view.
The circular-shaped focusing structures 101 to 105 are formed such that an additional focal power of 12 diopters is provided as compared to the focal power of the central clear zone 110. This additional focal power is recognized by the wearer as blur and is demonstrated e.g., in X. Li, C. Ding, Y. Li, E. W: Lim, Y. Gao, B. Fermigier, A. Yang, C. Chen, J. Bao, Influence of Lenslet Configuration on Short-Term Visual Performance in Myopia Control Spectacle Lenses, Front. Neurosci. 2021, 15:667329, doi: 10.3389/fnins.2021.667329. This additional focal power leads to a reduction of progression of myopia of the wearer.
The single vision coated lens 100 shown in figures 1 and 2 has a diameter of 7 cm. Therefore, the coated lens 100 of figure 1 requires an edging process to be fitted into a respective spectacle frame. The single vision coated lens 100 comprises five circular-shaped focusing structures 101 to 105. Said circular-shaped focusing structures 101 to 105 are concentrically arranged towards the optical center of the single vision coated lens 100. Moreover, the circular-shaped focusing structure 101 is surrounding the central clear zone 110 having a circular central clear zone width cw110 of 7.0 mm. The width w101 of the circular-shaped focusing structure 101 is 0.5 mm. The neighboring circular-shaped structure 102 is arranged concentrically to the inner circular-shaped structure 101, encircling the circular central clear zone 110, with a pitch p101 of 1.0 mm. The ratio of the width w101 and the pitch p101 results in a length-based fill factor of 50.0% and a surface-based fill factor of 46.9%.
Figure 2 shows a cross-sectional view of the single vision coated lens 100. The front surface 131 being the outermost surface of the coating and the front surface 133 of the lens substrate of the single vision coated lens 100 are spherically shaped. Within the scope of this invention the shape of the front surface 131 and the front surface 133 of the single vision coated lens 100 are not limited to a spherical shape, it also can be of aspherical, toroidal, atoroidal or even be freely formed in order to comply with wearer's individual needs.
Figure 2 demonstrates how to determine the inner onset io101 of a circular-shaped focusing structure 101 and the outer onset oo101 of a circular-shaped focusing structure 101, the width of a circular-shaped focusing structure w101 to w103, the pitch of two neighboring circular-shaped focusing structures p101 and the central clear zone width cw110. For simplicity reasons only the three circular-shaped focusing structures 101 to 103 are shown in figure 2 compared to the five circular-shaped focusing structures 101 to 105 shown in figure 1.
The determination of an inner onset and an outer onset of a circular-shaped focusing structure is explained exemplary for the circular-shaped focusing structure 101. The inner onset io101 of the circular-shaped focusing structure 101 is a point directly adjacent to the central clear zone 110. The outer onset oo101 of the circular-shaped focusing structure 101 is a point radially arranged to the inner onset io101 and directly adjacent to the peripheral clear zone 120.

The width w101 of the circular-shaped focusing structure 101 is the radial distance between the inner onset io101 and the outer onset oo101. The width w102 and w103 are determined accordingly with the inner onsets io102, io103 and the outer onsets oo102, oo103.
The pitch p101 of the circular-shaped focusing structure 101 is the radial distance between the inner onset io101 of the circular-shaped focusing structure 101 and the inner onset io102 of the circular-shaped focusing structure 102. The pitch w102 is determined accordingly with the inner onsets io102 and io103.
The central clear zone width cw110 of the single vision coated lens 100 is the diameter of the central clear zone 110.
The single vision coated lens 100 according to the embodiment of figures 1 and 2 discloses a central clear zone width cw110 which results in a better acceptance response of the wearer compared to the prior-art. Moreover, the length-based fill factor lf101 and the pitch p101 are designed such that, compared to the prior art, a better comfort and acceptance response of the wearer is achieved.
Summarizing, the design characteristics of the coated lens 100 with the specific characterizations and wearer satisfaction and visual acuity when looking through the periphery of the lens are as follows:
- pitch width: 1 mm
- zylinder width: 0.5 mm
- ADD power: 8D
- diameter clear zone: 9.4 mm
- length-based fill factor: 50%
- satisfaction of wearability (scale 1-10, The subjects of a study evaluated said design characteristics in a range from 1 to 10, wherein 10 equals to best possible wearability of a coated lens (e.g., a single vision coated lens with a length-based fill factor of 0%) and 1 equals to the worst possible wearability of a coated lens (e.g., a single vision coated lens with a length-based fill factor of 100%). A satisfaction of wearability greater or equal to 4.0 is considered as sufficient, hence children would probably accept such lenses with said satisfaction of wearability and would probably not to tend to dismiss such a coated lens): 6.1
- visual acuity @ 20°: 0.0 log MAR.

I Manufacture of the coated lenses

Examples 1 to 6

A transparent stamp comprising a structure was provided, the structure was made by precision machining in form of recesses in the concave surface of the transparent stamp. The so obtained concave surface of the transparent stamp was configured to provide five ring-shaped focusing structures to a coating composition. Each ring-shaped focusing structure formed a ring of contiguously connected lenslets on the coating composition. The transparent stamp was made of cyclic block copolymers ViviOn™ 1325, company USI Corporation. The radius of the concave surface of the transparent stamp was 175mm.
A coating composition comprising 58g of trimethylolpropane triglycidyl ether, 38g of pentaerythritol tetraacrylate and 4g of triarylsulfonium hexafluorophosphate (50% in propylene carbonate) was stirred until homogenous. The respective volume of the coating composition given in the table below was

applied to the concave surface of the stamp in form of a drop. The front surface of the respective lens substrate given in the table below was placed on the coating composition on the stamp. The radius of the convex front surface of the respective lens substrate was 175 mm. A press force as given in the table below was applied to the back surface of the respective lens substrate, thereby the coating composition spread to cover the complete convex front surface of the respective lens substrate and to fill the recesses in the concave surface of the transparent stamp. After UV precuring the coating composition through the stamp using the LED curing lamp Delolux 20, company DELO, with wavelength 365 nm for the time and with the UV dose given in the table below, the stamp was detached from the so coated lens. The obtained coated lens comprised the at least one ring-shaped focusing structure in form of protrusions protruding from the outermost surface of the precured coating composition. The precured coating composition was thermally cured for 2 hours at a temperature of 100°C.

Example	Lens substrate, uncut lens	Volume of coating composition [ml]	Viscosity of coating composition [mPas]	Press force [g]	UV dose [J/cm²]	Time [s]	Coating thickness [µm]
1	1.5 CR 39	0.7	300	0	10.5	40	80
2	1.60 MR-8	0.7		400	10.5	80	65
3	1.67 MR-7	0.6		500	10.5	80	55
4	1.67 MR-10	0.6		500	10.5	80	58
5	1.74 MR-174	0.7		400	10.5	80	62
6	1.53 Trivex	0.7		400	10.5	40	60

The so obtained coated lens was further coated by dip coating, on the back surface of the lens substrate and on the outermost surface of the coating comprised on the front surface of the respective lens substrate, with a primer coating composition.

The so obtained coated lens was further coated by dip coating with hard coating composition for example a hard coating composition according to EP 2 578 649 A1, example 2, and the primer coating composition and the hard coating composition were thermally cured for 3h at a temperature of 110°C, thus resulting in a primer coating thickness each of 0.5 µm and a hard coating thickness each of 2.0 µm.

To the so obtained coated lens an anti-reflective coating resulting in a five-layer stack, beginning from each outermost surface of the hard coating with SiO_2 (30 nm), CrO_2 (30 nm), SiO_2 (20 nm), CrO_2 (60 nm), SiO_2 (90 nm), was deposited under vacuum.

Finally, the so obtained coated lens was coated on each outermost stack layer of the anti-reflective coating with the clean coating composition Cotec 300+, company COTECH GmbH, resulting in a clean coating of 1 nm thickness.

Examples 7 to 12

A transparent stamp comprising a structure is provided, the structure was made by precision machining in form of recesses in the convex surface of the transparent stamp. The so obtained convex surface of the transparent stamp was configured to provide at least one ring-shaped focusing structure to a coating composition. The transparent stamp was made of cyclic block copolymers ViviOn™ 1325, company USI Corporation. The radius of the convex surface of the transparent stamp was 175mm. The pressure sensitive acrylate-based adhesive DELO PHOTOBOND PS4130, company DELO, was applied as coating composition in the respective volume in form of a drop to the concave back surface of the respective lens substrate, both as given in the table below. The radius of the concave back surface of the respective lens substrate was 175 mm. A press force as given in the table below was applied to the opposite surface of the transparent stamp, i.e., to the surface of the transparent stamp not comprising the structure, thereby the coating composition spread to cover the complete concave back surface of the respective lens substrate. After UV precuring the coating composition through the stamp using the LED curing lamp Delolux 20, company DELO, with wavelength 365 nm for the time and with the UV dose given in the table below, the stamp was detached from the so coated lens. The obtained coated lens comprised the at least one ring-shaped focusing structure in form of protrusions protruding from the outermost surface of the precured coating composition. The precured coating composition was thermally cured for 2 hours at a temperature of 100°C.

Example	Lens substrate, uncut lens	Volume of coating composition [ml]	Viscosity of coating composition [mPas]	Press force [g]	UV dose [J/cm^2]	Time [s]	Coating thickness [µm]
7	1.5 CR 39	1.5	300	1000	10.5	40	152
8	1.60 MR-8			1200	10.5	80	103
9	1.67 MR-7			1000	10.5	80	145
10	1.67 MR-10			800	10.5	80	158
11	1.74 MR-174			1200	10.5	80	121
12	1.53 Trivex			800	10.5	40	166

The so obtained coated lens was further coated by dip coating, on the front surface of the lens substrate and on the outermost surface of the coating comprised on the back surface of the respective lens substrate, with a primer coating composition.

The so obtained coated lens was further coated by dip coating with a hard coating composition, for example a hard coating composition according to EP 2 578 649 A1, example 2, and the primer coating composition and the hard coating composition were thermally cured for 3h at a temperature of 110°C, thus resulting in a primer coating thickness each of 1.5 µm and a hard coating thickness each of 3.0 µm.

To the so obtained coated lens an anti-reflective coating resulting in a five-layer stack, beginning from each outermost surface of the hard coating with SiO_2 (30 nm), CrO_2 (30 nm), SiO_2 (20 nm), CrO_2 (60 nm), SiO_2 (90 nm), was deposited under vacuum.

Finally, the so obtained coated lens was coated on each outermost stack layer of the anti-reflective coating with the clean coating composition Cotec 300+, company COTECH GmbH, resulting in a clean coating of 2 nm thickness.

Examples 13 to 18

The coated lenses according to the examples 13 to 18 were prepared as the coated lenses according to the examples 1 to 6, except that instead of the primer coating composition and the hard coating composition only the hard coating composition, for example the hard coating composition according to EP 2 578 649 A1, example 2, is applied by dip coating to the obtained coated lens, i.e., to the back surface of the respective lens substrate and the outermost surface of the coating comprised on the front surface of the respective lens substrate. The hard coating composition was thermally cured for 3h at a temperature of 110°C to result in a hard coating having a thickness, each on the front surface and on the back surface of the resulting coated lens of 1.2 µm.

Example 19

The hard coating composition according to EP 2 578 649 A1, example 2, was applied by spin coating to the concave surface of a transparent stamp according to the one provided in examples 1 to 6. The applied hard coating composition was precured for 10 minutes at a temperature of 60°C, thus resulting in a precured hard coating of a thickness of 2.7 µm, said thickness not taking into consideration the filled recesses in the concave surface of the transparent stamp.

A coating composition comprising 58g of trimethylolpropane triglycidyl ether, 38g of pentaerythritol tetraacrylate and 4g of triarylsulfonium hexafluorophosphate (50% in propylene carbonate) was stirred until homogenous. 0.7 ml of said coating composition was applied to the precured hard coating in form of a drop. The convex front surface of a lens substrate based on 1.60 MR-8 (uncut lens) with a radius of the convex front surface of 175 mm was placed on the coating composition. A press force of 400 g was applied to the back surface of the lens substrate, thereby the coating composition spread to cover the complete surface of the precured hard coating. After UV precuring the coating composition through the stamp using the LED curing lamp Delolux 20, company DELO, with wavelength 365 nm for 80s and with a UV dose of 10.5 J/cm^2, the stamp was detached from the so coated lens. The obtained coated lens comprised the at least one ring-shaped focusing structure in form of protrusions protruding from the outermost surface of the precured hard coating composition. The precured coating compositions were thermally cured for 2 hours at a temperature of 100°C.

The hard coating composition according to EP 2 578 649 A1, example 2, was applied by spin coating on the back surface of the lens substrate and thermally cured for 3h at a temperature of 110°C, thus resulting in a hard coating of a thickness of 3.0 µm.

Both, to the front surface and the back surface of the resulting coated lens, the anti-reflective coating and the clean coating of the examples 1 to 6 were applied.

Example 20

The coated lens according to the example 20 was prepared as the coated lens according to example 19, except that the convex front surface of the lens substrate comprised four rings of form of recesses, the recesses in each ring were formed as contiguously connected recesses. The recesses in the convex front surface of the lens substrate were made via a molding process.

Examples 21 to 26

A transparent stamp comprising a smooth concave surface is provided, i.e., a transparent stamp having a concave surface without a structure is provided. The transparent stamp was made of cyclic block copolymers ViviOn™ 1325, company USI Corporation. The radius of the concave surface of the transparent stamp was 175mm.

The pressure sensitive acrylate-based adhesive DELO PHOTOBOND PS4130, company DELO, was applied as first coating composition in the respective volume as given with respect to coating composition 1 in the table below, in form of a drop to the smooth concave surface of the transparent stamp. The front surface of the respective lens substrate given in the table below was placed on the coating composition on the stamp. The radius of the convex front surface of the respective lens substrate was 175 mm. The convex front surface of the lens substrate comprised four rings of form of recesses, the recesses in each ring were formed as contiguously connected recesses. The recesses in the convex front surface of the lens substrate were made via a molding process. A press force as given in the table below was applied to the back surface of the respective lens substrate, thereby the coating composition spread to cover the complete convex front surface of the respective lens substrate and filled the recesses in the convex front surface of the respective lens substrate. After UV precuring the coating composition 1 through the stamp using the LED curing lamp Delolux 20, company DELO, with wavelength 365 nm for the time and with the UV dose given in the table below with respect to coating composition 1, the stamp was detached from the so coated lens.

A second coating composition comprising 58g of trimethylolpropane triglycidyl ether, 38g of pentaerythritol tetraacrylate and 4g of triarylsulfonium hexafluorophosphate (50% in propylene carbonate) was stirred until homogenous. The respective volume of the second coating composition given in the table below with respect to coating composition 2 was applied to the concave surface of the stamp used in examples 1 to 6 in form of a drop.

The obtained coated lens was placed with the front surface, i.e., the outermost surface of the precured coating composition 1, on the coating composition 2 applied to the concave structured surface of the transparent stamp used in examples 1 to 6. A press force as given in the table below was applied to the back surface of the coated lens, i.e., to the respective lens substrate, thereby the coating composition 2 spread to cover the complete front surface of the coated lens and to fill the recesses in the concave surface of the transparent stamp. After UV precuring the coating composition 2 through the stamp using the LED curing lamp Delolux 20, company DELO, with wavelength 365 nm for the time and with the UV dose given in the table below, the stamp was detached from the so coated lens. The obtained coated lens comprised the at least one ring-shaped focusing structure in form of protrusions protruding from the outermost surface of the precured coating composition 2. The precured coating compositions 1 and 2 were thermally cured for 2 hours at a temperature of 100°C.

		Coating composition 1 (DELO PHOTOBOND PS4130)

Example	Lens substrate, uncut lens	Volume of coating composition [ml]	Press force [g]	UV dose [J/cm²]	Time [s]
21	1.5 CR 39	1.5	1000	8	40
22	1.60 MR-8				
23	1.67 MR-7				
24	1.67 MR-10				
25	1.74 MR-174				
26	1.53 Trivex				
		Coating composition 2			
21	1.5 CR 39	0.7	400	10	80
22	1.60 MR-8				
23	1.67 MR-7				
24	1.67 MR-10				
25	1.74 MR-174				
26	1.53 Trivex				

To the front surface and to the back surface of the obtained coated lens, the primer coating composition, the hard coating composition, the anti-reflective coating, and the clean coating as in examples 1 to 6 were applied.

Examples 27 to 32

The coated lenses according to the examples 27 to 32 were obtained as those according to examples 21 to 26, except that instead of coating composition 1 and coating composition 2 only coating composition 1 (DELO PHOTOBOND PS4130) was used.

Example 33 to 38

The coated lenses according to the examples 33 to 38 were prepared as those according to examples 21 to 26, except that the convex front surface of the lens substrate comprised four rings of form of recesses, the recesses in each ring were formed as contiguously connected recesses. The recesses in the convex front surface of the lens substrate were made via a molding process.

Examples 39 to 44

A transparent stamp as in examples 1 to 6 was provided. Additionally, another transparent stamp comprising a smooth concave surface is provided, i.e., a transparent stamp having a concave surface without a structure is provided. The transparent stamp was made of cyclic block copolymers ViviOn™ 1325, company USI Corporation. The radius of the concave surface of the transparent stamp was 175mm.

The pressure sensitive acrylate-based adhesive DELO PHOTOBOND PS4130, company DELO, was applied as first coating composition in the respective volume as given with respect to coating composition 1 in the table below, in form of a drop to the structured concave surface of the transparent stamp used in examples 1 to 6. The front surface of the respective lens substrate given in the table below was placed on the coating composition on the stamp. The radius of the convex front surface of the respective lens substrate was 175 mm. A press force as given in the table below was applied to the back surface of the respective lens substrate, thereby the coating composition spread to cover the complete convex front surface of the respective lens substrate and to fill the recesses in the concave surface of the transparent stamp. After UV precuring the coating composition 1 through the stamp using the LED curing lamp Delolux 20, company DELO, with wavelength 365 nm for the time and with the UV dose given in the table below with respect to coating composition 1, the stamp was detached from the so coated lens. The coated lens comprised protrusion protruding the outermost surface of the precured coating composition 1.

A second coating composition comprising 58g of trimethylolpropane triglycidyl ether, 38g of pentaerythritol tetraacrylate and 4g of triarylsulfonium hexafluorophosphate (50% in propylene carbonate) was stirred until homogenous. The respective volume of the second coating composition given in the table below with respect to coating composition 2 was applied to the concave smooth surface of the stamp described before in form of a drop.

The obtained coated lens was placed with the front surface, i.e., the outermost surface of the precured coating composition 1, on the coating composition 2 applied to the concave smooth surface of the transparent stamp. A press force as given in the table below was applied to the back surface of the coated lens, i.e., to the respective lens substrate, thereby the coating composition 2 spread to cover the complete front surface of the coated lens, including the protrusions obtained by coating composition 1. After UV precuring the coating composition 2 through the stamp using the LED curing lamp Delolux 20, company DELO, with wavelength 365 nm for the time and with the UV dose given in the table below, the stamp was detached from the so coated lens. The obtained coated lens comprised the at least one ring-shaped focusing structure in form of protrusions of precured coating composition 1 hidden within the precured coating composition 2. The precured coating compositions 1 and 2 were thermally cured for 2 hours at a temperature of 100°C.

		Coating composition 1 (DELO PHOTOBOND PS4130)			
Example	Lens substrate, uncut lens	Volume of coating composition [ml]	Press force [g]	UV dose [J/cm^2]	time [s]
39	1.5 CR 39	1.5	1000	8	40
40	1.60 MR-8				
41	1.67 MR-7				
42	1.67 MR-10				
43	1.74 MR-174				
44	1.53 Trivex				
		Coating composition 2			
39	1.5 CR 39	0.7	400	10	80
40	1.60 MR-8				
41	1.67 MR-7				
42	1.67 MR-10				

43	1.74 MR-174				
44	1.53 Trivex				

To the front surface and to the back surface of the obtained coated lens, the primer coating composition, the hard coating composition, the anti-reflective coating and the clean coating as in examples 1 to 6 were applied.

Examples 45 to 50

The coated lenses according to the examples 38 to 43 were obtained as the coated lenses according to the examples 32 to 37, except that instead of coating composition 1 coating composition 2 and instead of coating composition 2 coating composition 1 was used.

Comparative example 1

A transparent stamp as in examples 1 to 6 was provided.

0.8 ml of the hard coating composition according to EP 2 578 649 A1, example 2, was applied in form of a drop to the concave surface of the transparent stamp. The convex surface of a lens substrate based on 1.60 MR-8 (uncut lens) with a radius of the convex front surface of 175 mm was placed on the hard coating composition. The hard coating composition spread to cover the complete surface of the lens substrate and to fill the recesses in the concave surface of the transparent stamp. After thermally curing the hard coating composition for 3h at a temperature of 100°C, the stamp was detached from the hard coated lens. The obtained coated lens comprised the at least one ring-shaped focusing structure in form of protrusions protruding from the outermost surface of the hard coating.

Comparative example 2

The coated lens according to comparative example 2 was obtained as the coated lens of example 2, except that both the primer coating composition and the hard coating composition of example 2 were not applied.

Comparative example 3

The coated lens according to comparative example 3 was obtained as the coated lens of example 2, except that the coating composition applied in form of a drop to the concave surface of the transparent stamp comprised 9.5g of trimethylolpropane triglycidyl ether, 86.5g of pentaerythritol tetraacrylate and 4g of triarylsulfonium hexafluorophosphate (50% in propylene carbonate).

Comparative example 4

The coated lens according to comparative example 4 was obtained as the coated lens according to example 3, except that the transparent stamp was based on the polycarbonate LEXAN™ Resin OQ3820, company Sabic Corporation.

Comparative example 5, stamping a coating

A transparent stamp as in examples 1 to 6 was provided.

A coating composition comprising 58g of trimethylolpropane triglycidyl ether, 38g of pentaerythritol tetraacrylate and 4g of triarylsulfonium hexafluorophosphate (50% in propylene carbonate) was stirred until homogenous and applied in a thickness of 40 µm to the front surface of a substrate based on 1.60 MR-8 (uncut lens), the lens substrate had a radius of the convex front surface of 175 mm. The coating composition was precured for 80s with a UV dose of 10.5 J/cm^2 using the LED curing lamp DELOLUX 20 with a wavelength of 365 nm, followed by thermal cure for 2h at a temperature of 100°C. The coated front surface of the obtained coated lens was placed and pressed under a press force of 1 MPa and application of a temperature of 80°C to the concave surface of the transparent stamp. The coated lens and the stamp were detached, the coatings as in examples 1 to 6 were applied to both the front surface and the back surface of the obtained coated lens.

II Characterization of the coated lenses

Coated Lens	Detaching performance (Detach the precured coated lens from the stamp)	Cosmetic	Adhesion of anti-reflection coating	Adhesion of coating adjacent to lens substrate	Design Tangential radius of lenslet [mm]	Tangential Radius of Lenslet after AR coating [mm]
Example2	Easy to detach	Pass	Pass	Pass	40.85	60.62
Example 14	Easy to detach	Pass	Pass	Pass	40.85	48.5
Example 19	Easy to detach	Pass	Pass	Pass	40.85	40.84
Example 20	Easy to detach	Pass	Pass	Pass	-57(radius of the lenslet on lens substrate) 50(radius of the lenslet on the hard coating)	-57radius of the lenslet on lens substrate 50.5 (radius of the lenslet on the hard coating
Comparative Example1	Easy to detach	Bubbles and cracks on the hard coating; due to the volatilizable components in the hard coating composition.	NA	NA	40.85	NA
Comparative Example2	Easy to detach	Pass	Fail	Pass	40.85	41
Comparative Example3	Easy to detach	Pass	Pass	Fail	40.85	60
Comparative Example4	stamp damaged during detaching, due to strong adhesion	NA	NA	NA	40.85	NA

Comparative Example5	Easy to detach	Pass	Pass	Pass	40.85	Lenslet not detected

The cosmetic of the coated lenses according to the examples and comparative examples was determined by visual inspection.

The adhesion of the coating to the coated lens was evaluated by the cross-cut test. This test applies and removes pressure sensitive tape (3M Scotch 600) over the two cuts made in the coating and into the substrate. The cuts are made by a blade tool with 6 blades parallelly installed, 25 grids of size 1mm x 1mm is formed by cutting perpendicularly. The ranking is made based on the percentage of the delaminated area to the grids area according to BYK Gardner catalogue “QC solutions for coatings and plastics”, 2018, page 158. If the delaminated area is more than 5%, the adhesion is considered as fail.

Claims

1. Coated lens comprising a coating composition, said coating composition comprising a stamping, characterized in that said coating composition comprises at least one component selected from the group consisting of at least one epoxide component and at least one (meth)acrylate component.

2. Coated lens comprising a coating, said coating comprising a stamping, characterized in that said coating is based on a coating composition comprising at least one component selected from the group consisting of at least one epoxide component and at least one (meth)acrylate component, and in that said stamping is having in a domain of said stamping a surface power which is different to a surface power of a lens surface of the coated lens comprising said coating outside said domain of said stamping.

3. Coated lens according to any one of the preceding claims 1 and 2, characterized in that said coating composition comprises said at least one epoxide component and said at least one (meth)acrylate component in a weight ratio selected from at least one of the following ranges:
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.64 to 4.3,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.7 to 4.1,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.8 to 4.0,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 1.0 to 3.0.

4. Coated lens according to any one of the preceding claims, characterized in that said coating composition comprises said at least one epoxide component in a total amount within a range selected from at least one of the following ranges:
- said total amount being within a range of from 39% by weight to 81% by weight,
- said total amount being within a range of from 45% by weight to 75% by weight,
- said total amount being within a range of from 50% by weight to 70% by weight,
- said total amount being within a range of from 55% by weight to 65% by weight,
each total amount of said at least one epoxide component being based on the total weight of the sum of said at least one epoxide component and said at least one (meth)acrylate component, and said at least one (meth)acrylate component in a total amount within a range selected from at least one of the following ranges:
- said total amount being within a range of from 19% by weight to 61% by weight,
- said total amount being within a range of from 25% by weight to 55% by weight,
- said total amount being within a range of from 30% by weight to 50% by weight,
- said total amount being within a range of from 35% by weight to 45% by weight,

each total amount of said at least one (meth)acrylate component being based on the total weight of the sum of said at least one epoxide component and said at least one (meth)acrylate component.

5. Coated lens according to any one of the preceding claims, characterized in that said coating composition is having a viscosity within a range selected from at least one of the following ranges:
- said viscosity being within a range of from 50 mPas to 600 mPas,
- said viscosity being within a range of from 100 mPas to 500 mPas,
- said viscosity being within a range of from 150 mPas to 400 mPas,
- said viscosity being within a range of from 250 mPas to 350 mPas,
each viscosity being determined using an Ubbelohde viscometer at a working temperature being within a range selected from at least one of the following ranges:
- said working temperature being within a range of from -20°C to 100°C,
- said working temperature being within a range of from 0°C to 60°C,
- said working temperature being within a range of from 10°C to 40°C,
- said working temperature being within a range of from 17°C to 30°C.

6. Coated lens according to any one of the preceding claims, the coated lens comprising a lens substrate having at least a front surface and a back surface, said lens substrate comprising on at least one of said front surface and said back surface said coating composition, characterized in that said coating composition
- on said front surface comprises a surface facing away from said front surface, at least said surface comprising said stamping,
- on said back surface comprises a surface facing away from said back surface, at least said surface comprising said stamping.

7. Coated lens according to any one of the preceding claims 1, 3 to 6, the coated lens comprising a coating, characterized in that said coating is based on said coating composition.

8. Coated lens according to the preceding claim 7, characterized in that said coating has an indentation hardness selected from at least one of the following ranges:
- said indentation hardness being within a range of from 50MPa to 600MPa,
- said indentation hardness being within a range of from 100MPa to 400MPa,
- said indentation hardness being within a range of from 150 MPa to 350MPa,
- said indentation hardness being within a range of from 200MPa to 300MPa.

9. Coated lens according to any one of the preceding claims 7 and 8, characterized in that the coated lens comprises a lens substrate, said lens substrate having at least a front surface and a back surface, at least one of said front surface and said back surface has a surface topography selected from at least one of the following surfaces,
- said surface topography being of a spherical surface,
- said surface topography being of a cylindrical surface,

- said surface topography being of an aspherical surface,
- said surface topography being of a toroidal surface,
- said surface topography being of an atoroidal surface,
- said surface topography being of a power-variation surface,
- said surface topography being of a meridionally-compensated aspherical surface.

10. Coated lens according to the preceding claim 9, characterized in that said surface topography additionally comprises at least one of
- at least one protrusion,
- at least one recess.

11. Coated lens according to any one of the preceding claims 7 to 10, characterized in that said stamping comprises at least one of
    - at least one protrusion,
    - at least one recess.

12. Coated lens according to any one of the preceding claims 1 to 11, characterized in that the coated lens comprises an additional coating, said additional coating being an outermost coating and being selected from at least one of the group consisting of:
    - a hard coating,
    - a coating based on said coating composition,
    - a coating based on said composition and a hard coating, the hard coating being the outermost coating thereof.

13. Coated lens according to claim 12, characterized in that said additional coating adapts to said stamping.

14. Coated lens according to any one of the preceding claims 7 to 12, characterized in that said stamping provides in a domain of said stamping a surface power to a lens surface of the coated lens which is different from a surface power of a lens surface of the coated lens comprising said coating outside said domain of said stamping, a difference in surface power being within at least one range selected from the following ranges:
    - said difference in surface power is within a range of larger than 3 dioptres and equal to or lower than 14 dioptres;
    - said difference in surface power is within a range of larger than 5 dioptres and equal to or lower than 13 dioptres;
    - said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres.

15. Coated lens according to claim 2, characterized in that a difference in surface power is within at least one range selected from the following ranges:

- - said difference in surface power is within a range of larger than 3 dioptres and equal to or lower than 14 dioptres;
- - said difference in surface power is within a range of larger than 5 dioptres and equal to or lower than 13 dioptres;
- - said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres.

16. Coated lens according to the preceding claim 13, characterized in that said stamping provides in a domain of said stamping a surface power to the coated lens which is different from a surface power of a lens surface of the coated lens comprising said additional coating in a domain outside said stamping, a difference in surface power being within at least one range selected from the following ranges:
    - said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
    - said difference in surface power is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;
    - said difference in surface power is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

17. Coated lens according to any one of the preceding claims 7 to 16, characterized in that said stamping of said coating and/or said additional coating comprises one ring-shaped focusing structure or more ring-shaped focusing structures.

18. Coated lens according to the preceding claim 17, characterized in that said one ring shaped focusing structure has a respective width (w101, w102, w103, ...) or said more ring-shaped focusing structures have a respective width (w101, w102, w103, ...), and at least one additional feature selected from the group consisting of:
    (i) a central clear zone (110, 210, ...) having a central clear zone width (cw110, cw210, ...) within a range of 6 mm to 9.4 mm and said width (w101, w102, ...) being equal to or lower than 0.7 mm;
    (ii) said width (w101, w102, w103, ...) being lower than 0.5 mm;
    (iii) a surface-based fill factor (sf101, sf201) defined as a surface area ratio of
    - a surface area of an innermost ring-shaped focusing structure of more ring-shaped focusing structures (101, 102, 103, ...)
    and a sum
    - of said surface area of said innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...) and an area of a peripheral clear zone (110, 210, ...),
    said surface-based fill factor (sf101, sf201) being within a range of larger than 17% and equal to or lower than 70% for said width (w101, w102, w103, ...) of said more ring-shaped focusing structures (101, 102, 103, ...) in a range of 0.6 mm to 0.7 mm;

(iv) a surface-based fill factor (sf101, sf201) defined as a surface area ratio of
- a surface area of an innermost ring-shaped focusing structure of more ring-shaped focusing structures (101, 102, 103, ...)
and a sum
- of said surface area of said innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...) and an area of a peripheral clear zone (110, 210, ...),
said surface-based fill factor (sf101, sf201) being within a range of larger than 15% and equal to or lower than 60% for said width (w101, w102, w103, ...) of said more ring-shaped focusing structures (101, 102, 103, ...) in a range of 0.5 mm to 0.6 mm;

(v) a surface-based fill factor (sf101, sf201) defined as a surface area ratio of
- a surface area of an innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...)
and a sum
- of said surface area of said innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...) and an area of a peripheral clear zone (110, 210, ...),
said surface-based fill factor (sf101, sf201) being within a range of larger than 6% and equal to or lower than 50% for said width (w101, w102, w103, ...) of said more ring-shaped focusing structures (101, 102, 103, ...) lower than 0.5 mm.

19. Coated lens according to the preceding claim 18, characterized in that that said width (w101, w102, w103) is within at least one range selected from the group of ranges consisting of:
   (i) said width (w101, w102, w103, ...) is within a range of larger than 0.2 mm and equal to or lower than 0.7 mm;
   (ii) said width (w101, w102, w103, ...) is within a range of larger than 0.3 mm and equal to or lower than 0.7 mm;
   (iii) said width (w101, w102w, 103, ...) is equal to or lower than 0.6 mm;
   (iv) said width (w101, w102, w103, ...) is within a range of larger than 0.2 mm and equal to or lower than 0.6 mm;
   (v) said width (w101, w102, w103, ...) is within a range of larger than 0.3 mm and equal to or lower than 0.6 mm;
   (vi) said width (w101, w102, w103, ...) is equal to or lower than 0.5 mm;
   (vii) said width (w101, w102, w103, ...) is within a range of larger than 0.2 mm and equal to or lower than 0.5 mm;
   (viii) said width (w101, w102, w103, ...) is within a range of larger than 0.3 mm and equal to or lower than 0.5 mm.

20. Coated lens according to any one of the preceding claims 18 and 19, characterized in that said central clear zone width (cw110, cw210,...) is within at least one range selected from the group of ranges consisting of:

(i) said central clear zone width (cw110, cw210, cw310, ...) is within a range of larger than 6 mm and equal to or lower than 7 mm;
(ii) said central clear zone width (cw110, cw210, cw310, ...) is within a range of larger than 7 mm and equal to or lower than 9.4 mm.

21. Coated lens according to any one of the preceding claims 17 to 20, characterized on that said at least one ring-shaped focusing structure (101, 102, 103, ...) is providing an additional power (ADD) as compared to said central clear zone (110, 210, ...) within at least one range selected from the group of ranges consisting of:
(i) said additional power (ADD) is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
(ii) said additional power (ADD) is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;
(iii) said additional power (ADD) is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

22. Coated lens comprising a coating, characterized in that said coating is a core shell coating, said core shell coating comprising a stamping, said stamping having in a domain of said stamping a surface power which is different from a surface power of a lens surface comprising said core shell coating outside said domain of said stamping.

23. Coated lens according to the preceding claim 22, characterized in that a core of said core shell coating is based on a coating composition, said coating composition comprises at least one component selected from the group consisting of at least one epoxide component and at least one (meth)acrylate component.

24. Coated lens according to claim 23, characterized in that said coating composition comprises said at least one epoxide component and said at least one (meth)acrylate component in a weight ratio selected from at least one of the following ranges:
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.64 to 4.3,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.7 to 4.1,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.8 to 4.0,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 1.0 to 3.0.

25. Coated lens according to any one of the preceding claims 23 and 24, characterized in that said coating composition comprises said at least one epoxide component in a total amount within a range selected from at least one of the following ranges:

- said total amount being within a range of from 39% by weight to 81% by weight,
- said total amount being within a range of from 45% by weight to 75% by weight,
- said total amount being within a range of from 50% by weight to 70% by weight,
- said total amount being within a range of from 55% by weight to 65% by weight,

each total amount of said at least one epoxide component being based on the total weight of the sum of said at least one epoxide component and said at least one (meth)acrylate component, and said at least one (meth)acrylate component in a total amount within a range selected from at least one of the following ranges:

- said total amount being within a range of from 19% by weight to 61% by weight,
- said total amount being within a range of from 25% by weight to 55% by weight,
- said total amount being within a range of from 30% by weight to 50% by weight,
- said total amount being within a range of from 35% by weight to 45% by weight,

each total amount of said at least one (meth)acrylate component being based on the total weight of the sum of said at least one epoxide component and said at least one (meth)acrylate component.

26. Coated lens according to any one of the preceding claims 23 to 25, characterized in that said coating composition is having a viscosity within a range selected from at least one of the following ranges:
    - said viscosity being within a range of from 50 mPas to 600 mPas,
    - said viscosity being within a range of from 100 mPas to 500 mPas,
    - said viscosity being within a range of from 150 mPas to 400 mPas,
    - said viscosity being within a range of from 250 mPas to 350 mPas,

    each viscosity being determined using an Ubbelohde viscometer at a working temperature being within a range selected from at least one of the following ranges:
    - said working temperature being within a range of from -20°C to 100°C,
    - said working temperature being within a range of from 0°C to 60°C,
    - said working temperature being within a range of from 10°C to 40°C,
    - said working temperature being within a range of from 17°C to 30°C.

27. Coated lens according to any one of the preceding claims 23 to 26, characterized in that said core comprises a coating, said coating being based on said coating composition.

28. Coated lens according to the preceding claim 27, characterized in that said coating has an indentation hardness selected from at least one of the following ranges:
    - said indentation hardness being within a range of from 50MPa to 600MPa,
    - said indentation hardness being within a range of from 100MPa to 400MPa,
    - said indentation hardness being within a range of from 150 MPa to 350MPa,
    - said indentation hardness being within a range of from 200MPa to 300MPa.

29. Coated lens according to any one of the preceding claims 22 to 28, characterized in that a shell of said core shell coating is a hard coating.

30. Coated lens according to any one of the preceding claims 22 to 29, characterized in that said core and said shell of said core shell coating comprises a stamping.

31. Coated lens according to any one of the preceding claims 22 to 30, characterized in that said stamping comprises at least one of
- at least one protrusion,
- at least one recess.

32. Coated lens according to any one of the preceding claims 22 to 31, characterized in that said stamping provides a difference in surface power is within at least one range selected from the following ranges:
- said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
- said difference in surface power is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;
- said difference in surface power is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

33. Coated lens according to any one of the preceding claims 22 to 31, characterized in that said the coated lens comprises a lens substrate, said lens substrate having at least a front surface and a back surface, at least one of said front surface and said back surface has a surface topography selected from at least one of the following surfaces,
- said surface topography being of a spherical surface,
- said surface topography being of a cylindrical surface,
- said surface topography being of an aspherical surface,
- said surface topography being of a toroidal surface,
- said surface topography being of an atoroidal surface,
- said surface topography being of a power-variation surface,
- said surface topography being of a meridionally-compensated aspherical surface.

34. Coated lens according to the preceding claim 33, characterized in that said surface topography additionally comprises at least one of
- at least one protrusion,
- at least one recess.

35. Coated lens according to any one of the preceding claims 22 to 34, characterized in that said stamping of said core shell coating comprises at least one ring-shaped focusing structure.

36. Coated lens according to any one of the preceding claims 22 to 35, the coated lens comprising a lens substrate having at least a front surface and a back surface, said lens substrate comprising on at least one of said front surface and said back surface at least one coating, characterized in that said at least one coating comprises said core shell coating, said core shell coating
- on said front surface comprises a surface facing away from said front surface, said surface comprising said stamping,
- on said back surface comprises a surface facing away from said back surface, at least said surface comprising said stamping.

37. Coated lens (100) comprising a coating, characterized in that said coating comprises a stamping, said stamping comprising one ring-shaped focusing structure (101, 102, 103, ...) or more ring-shaped focusing structures (101, 102, 103, ...), the one or more ring-shaped focusing structure(s) having a respective width (w101, w102, w103, ...), and at least one additional feature selected from the group consisting of:
(i) a central clear zone (110, 210, ...) having a central clear zone width (cw110, cw210, ...) within a range of 6 mm to 9.4 mm and said width (w101, w102, ...) being equal to or lower than 0.7 mm;
(ii) said width (w101, w102, w103, ...) being lower than 0.5 mm;
(iii) a surface-based fill factor (sf101, sf201) defined as a surface area ratio of
- a surface area of an innermost ring-shaped focusing structure of said more ring-shaped focusing structure (101, 102, 103, ...)
and a sum
- of said surface area of said innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...) and an area of a peripheral clear zone (110, 210, ...),
said surface-based fill factor (sf101, sf201) being within a range of larger than 17% and equal to or lower than 70% for said width (w101, w102, w103, ...) of said more ring-shaped focusing structures (101, 102, 103, ...) in a range of 0.6 mm to 0.7 mm;
(iv) a surface-based fill factor (sf101, sf201) defined as a surface area ratio of
- a surface area of an innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...)
and a sum
- of said surface area of said innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...) and an area of a peripheral clear zone (110, 210, ...),
said surface-based fill factor (sf101, sf201) being within a range of larger than 15% and equal to or lower than 60% for said width (w101, w102, w103, ...) of said more ring-shaped focusing structures (101, 102, 103, ...) in a range of 0.5 mm to 0.6 mm;
(v) a surface-based fill factor (sf101, sf201) defined as a surface area ratio of

- a surface area of an innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...)

and a sum

- of said surface area of said innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...) and an area of a peripheral clear zone (110, 210, ...),

said surface-based fill factor (sf101, sf201) being within a range of larger than 6% and equal to or lower than 50% for said width (w101, w102, w103, ...) of said more ring-shaped focusing structures (101, 102, 103, ...) lower than 0.5 mm.

38. Coated lens (100) according to claim 37, characterized in that said width (w101, w102, w103) is within at least one range selected from the group of ranges consisting of:
    (i) said width (w101, w102, w103, ...) is within a range of larger than 0.2 mm and equal to or lower than 0.7 mm;
    (ii) said width (w101, w102, w103, ...) is within a range of larger than 0.3 mm and equal to or lower than 0.7 mm;
    (iii) said width (w101, w102w, 103, ...) is equal to or lower than 0.6 mm;
    (iv) said width (w101, w102, w103, ...) is within a range of larger than 0.2 mm and equal to or lower than 0.6 mm;
    (v) said width (w101, w102, w103, ...) is within a range of larger than 0.3 mm and equal to or lower than 0.6 mm;
    (vi) said width (w101, w102, w103, ...) is equal to or lower than 0.5 mm;
    (vii) said width (w101, w102, w103, ...) is within a range of larger than 0.2 mm and equal to or lower than 0.5 mm;
    (viii) said width (w101, w102, w103, ...) is within a range of larger than 0.3 mm and equal to or lower than 0.5 mm.

39. Coated lens (100) according to any one of the preceding claims 37 and 38, characterized in that said central clear zone width (cw110, cw210,...) is within at least one range selected from the group of ranges consisting of:
    (i) said central clear zone width (cw110, cw210, cw310, ...) is within a range of larger than 6 mm and equal to or lower than 7 mm;
    (ii) said central clear zone width (cw110, cw210, cw310, ...) is within a range of larger than 7 mm and equal to or lower than 9.4 mm.

40. Coated lens (100) according to any one of the preceding claims 37 to 39, characterized in that said at least one ring-shaped focusing structure (101, 102, 103, ...) is providing an additional power (ADD) as compared to said central clear zone (110, 210, ...) within at least one range selected from the group of ranges consisting of:
    (i) said additional power (ADD) is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;

(ii) said additional power (ADD) is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;

(iii) said additional power (ADD) is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

41. Coated lens according to any one of the preceding claims 22 to 40, characterized in that said coating is selected from the group consisting of
- a hard coating,
- said core shell coating.

42. Coated lens according to any one of the preceding claims 7 to 41, characterized in that the coated lens comprises at least one further coating, said at least one further coating being selected from the group consisting of
- an anti-reflective coating,
- an anti-reflective coating and a clean coating,
- an anti-reflective coating and an anti-fog coating.

43. Digital twin of a coated lens according to any one of the preceding claims, the digital twin being for the purpose of a use for manufacturing the coated lens.

44. Digital twin according to preceding claim 43 being stored on a computer-readable data carrier.

45. Digital twin according to preceding claim 43 being transformed into a data carrier signal.

46. Method for manufacturing a coated lens, the method comprising a step of
- stamping a coating composition,
characterized in that said coating composition comprises at least one component selected from at least one epoxide component and at least one (meth)acrylate component.

47. Method for manufacturing a coated lens, the method being characterized in a step of
- stamping a coating composition such that a surface power in a domain of a stamping is different from a surface power of a lens surface comprising said coating composition outside said domain of said stamping.

48. Method according to claim 47, characterized in that a difference in surface power is within at least one of the following ranges:
- said difference in surface power is within a range of larger than 3 dioptres and equal to or lower than 14 dioptres;
- said difference in surface power is within a range of larger than 5 dioptres and equal to or lower than 13 dioptres;

- said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres.

49. Method according to any one of the preceding claims 46 to 48, characterized in that said coating composition comprises said at least one epoxide component and said at least one (meth)acrylate component in a weight ratio selected from at least one of the following ranges:
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.64 to 4.3,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.7 to 4.1,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.8 to 4.0,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 1.0 to 3.0.

50. Method according to any one of the preceding claims 46 to 49, characterized in that said coating composition comprises said at least one epoxide component in a total amount within a range selected from at least one of the following ranges:
- said total amount being within a range of from 39% by weight to 81% by weight,
- said total amount being within a range of from 45% by weight to 75% by weight,
- said total amount being within a range of from 50% by weight to 70% by weight,
- said total amount being within a range of from 55% by weight to 65% by weight,

each total amount of said at least one epoxide component being based on the total weight of the sum of said at least one epoxide component and said at least one (meth)acrylate component, and said at least one (meth)acrylate component in a total amount within a range selected from at least one of the following ranges:
- said total amount being within a range of from 19% by weight to 61% by weight,
- said total amount being within a range of from 25% by weight to 55% by weight,
- said total amount being within a range of from 30% by weight to 50% by weight,
- said total amount being within a range of from 35% by weight to 45% by weight,

each total amount of said at least one (meth)acrylate component being based on the total weight of the sum of said at least one epoxide component and said at least one (meth)acrylate component.

51. Method according to any one of the preceding claims 46 to 50, characterized in that said coating composition is having a viscosity within a range selected from at least one of the following ranges:
- said viscosity being within a range of from 50 mPas to 600 mPas,
- said viscosity being within a range of from 100 mPas to 500 mPas,
- said viscosity being within a range of from 150 mPas to 400 mPas,
- said viscosity being within a range of from 250 mPas to 350 mPas,

each viscosity being determined using an Ubbelohde viscometer at a working temperature being within a range selected from at least one of the following ranges:
- said working temperature being within a range of from -20°C to 100°C,
- said working temperature being within a range of from 0°C to 60°C,
- said working temperature being within a range of from 10°C to 40°C,
- said working temperature being within a range of from 17°C to 30°C.

52. Method according to any one of the preceding claims 46 to 51, characterized in that said stamping provides to said coating composition at least one of
- at least one protrusion,
- at least one recess.

53. Method according to any one of the preceding claims 46 to 52, characterized in that the method comprises a first additional step of
- curing said coating composition resulting in a coating.

54. Method according to the preceding claim 53, characterized in that said stamping provides in a domain of said stamping a surface power which is different to a surface power of a lens surface of the coated lens comprising said coating outside said domain of said stamping, a difference in surface power being within at least one range selected from the following ranges:
- said difference in surface power is within a range of larger than 3 dioptres and equal to or lower than 14 dioptres;
- said difference in surface power is within a range of larger than 5 dioptres and equal to or lower than 13 dioptres;
- said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres.

55. Method according to any one of the preceding claims 53 and 54, characterized in that the method comprises a second additional step of
- applying an additional coating composition, said additional coating composition being an outermost coating composition and being selected from the group consisting of
  - o a hard coating composition,
  - o said coating composition,
  - o said coating composition and a hard coating composition, the hard coating composition being the outermost thereof.

56. Method according to the preceding claim 55, characterized in that
- applying said additional coating to adapt to said coating.

57. Method according to any one of the preceding claims 55 and 56, characterized in that in a domain of said stamping a surface power is different to a surface power of a lens surface comprising said

additional coating outside said domain of said stamping, a difference in surface power being within at least one range selected from the following ranges:

- said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
- said difference in surface power is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;
- said difference in surface power is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

58. Method for manufacturing a coated lens, the method comprising a step of
    - stamping a first coating composition, thereby transferring at least one of a second coating composition and a second coating to said first coating composition,

    characterized in that said first coating composition comprises at least one component selected from the group consisting of at least one epoxide component and at least one (meth)acrylate component.

59. Method for manufacturing a coated lens, the method being characterized in a step of
    - stamping a first coating composition, thereby transferring at least one of a second coating composition and a second coating to said first coating composition, such as in a domain of a stamping a surface power is different from a surface power of a lens surface comprising said first coating composition and at least one of said second coating composition and said second coating outside said domain of said stamping.

60. Method according to claim 59, characterized in that a difference in surface power is selected from at least one range of the following group of ranges:
    - said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
    - said difference in surface power is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;
    - said difference in surface power is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

61. Method for manufacturing a coated lens, the method being characterized in a step of
    - stamping a first coating composition, thereby transferring at least one of a second coating composition and a second coating to said first coating composition, such as a stamping comprises one ring-shaped structure or more ring-shaped structures.

62. Method according to any one of preceding claims 58 to 60, characterized in that said first coating composition comprises said at least one epoxide component and said at least one (meth)acrylate component in a weight ratio selected from at least one of the following ranges:

- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.64 to 4.3,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.7 to 4.1,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 0.8 to 4.0,
- a weight ratio of epoxide component to (meth)acrylate component being within a range of from 1.0 to 3.0.

63. Method according to any one of the preceding claims 58 to 62, characterized in that said first coating composition comprises said at least one epoxide component in a total amount within a range selected from at least one of the following ranges:
- said total amount being within a range of from 39% by weight to 81% by weight,
- said total amount being within a range of from 45% by weight to 75% by weight,
- said total amount being within a range of from 50% by weight to 70% by weight,
- said total amount being within a range of from 55% by weight to 65% by weight,

each total amount of said at least one epoxide component being based on the total weight of the sum of said at least one epoxide component and said at least one (meth)acrylate component, and said at least one (meth)acrylate component in a total amount within a range selected from at least one of the following ranges:
- said total amount being within a range of from 19% by weight to 61% by weight,
- said total amount being within a range of from 25% by weight to 55% by weight,
- said total amount being within a range of from 30% by weight to 50% by weight,
- said total amount being within a range of from 35% by weight to 45% by weight,

each total amount of said at least one (meth)acrylate component being based on the total weight of the sum of said at least one epoxide component and said at least one (meth)acrylate component.

64. Method according to any one of the preceding claims 58 to 63, characterized in that said first coating composition is having a viscosity within a range selected from at least one of the following ranges:
- said viscosity being within a range of from 50 mPas to 600 mPas,
- said viscosity being within a range of from 100 mPas to 500 mPas,
- said viscosity being within a range of from 150 mPas to 400 mPas,
- said viscosity being within a range of from 250 mPas to 350 mPas,

each viscosity being determined using an Ubbelohde viscometer at a working temperature being within a range selected from at least one of the following ranges:
- said working temperature being within a range of from -20°C to 100°C,
- said working temperature being within a range of from 0°C to 60°C,
- said working temperature being within a range of from 10°C to 40°C,
- said working temperature being within a range of from 17°C to 30°C.

65. Method according to any one of the preceding claims 58 to 64, characterized in that
- said second coating composition is a hard coating composition,
- said second coating is a hard coating.

66. Method according to any one of the preceding claims 58 to 65, characterized in that the method comprises the additional step of
- curing said first coating composition and said second coating composition resulting in a coating and a hard coating.

67. Method according to any one of the preceding claims 58 to 66, characterized in that in a domain of said stamping said stamping provides a surface power to a lens surface comprising said hard coating which is different to a surface power of said lens surface outside said domain of said stamping, a difference in surface power being within at least one range selected from the following ranges:
- said difference in surface power is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
- said difference in surface power is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;
- said difference in surface power is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

68. Method for manufacturing a coated lens according to any one of the preceding claims 46 to 54, the coated lens comprising a lens substrate and at least one coating, the method comprising at least the following steps in the given order:
(a) applying said coating composition to at least one of
- a front surface of said lens substrate,
- a back surface of said lens substrate,
(b) applying a surface of a stamp to at least one of
- said front surface comprising said coating composition, and
- said back surface comprising said coating composition,
thereby stamping said coating composition between at least one of
- said front surface and said surface of said stamp, and
- said back surface and said surface of said stamp,
or
(a') applying said coating composition to a surface of a stamp,
(b') applying at least one of a front surface of said lens substrate and a back surface of said lens substrate to said surface of said stamp comprising said coating composition,
thereby stamping said coating composition between at least one of
- said front surface and said surface of said stamp,
- said back surface and said surface of said stamp,

(c), (c') precuring said coating composition resulting in a precured coating,
(d), (d') removing said stamp from said precured coating,
(e), (e') curing said precured coating resulting in a coating,
characterized in that
said stamp is structured to provide (i) at least one protrusion, (ii) at least one recess, (iii) at least one protrusion and at least one recess to said coating composition.

69. Method according to the preceding claim 68, characterized in that the method comprises the additional steps of
(f) (f') applying an additional coating composition to said coating, said coating composition being a hard coating composition,
(e) (e') curing said hard coating composition resulting in a hard coating.

70. Method according to the preceding claim 69, characterized in that said stamp is structured to provide to an outermost surface of said hard coating (i) at least one protrusion, (ii) at least one recess, (iii) at least one protrusion and at least one recess in form of one or more ring-shaped focusing structures having a respective width (w101, w102, w103, ...), and at least one additional feature selected from the group consisting of:
(i) a central clear zone (110, 210, ...) having a central clear zone width (cw110, cw210, ...) within a range of 6 mm to 9.4 mm and said width (w101, w102, ...) being equal to or lower than 0.7 mm;
(ii) said width (w101, w102, w103, ...) being lower than 0.5 mm;
(iii) a surface-based fill factor (sf101, sf201) defined as a surface area ratio of
- a surface area of an innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...)
and a sum
- of said surface area of said innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...) and an area of a peripheral clear zone (110, 210, ...),
said surface-based fill factor (sf101, sf201) being within a range of larger than 17% and equal to or lower than 70% for said width (w101, w102, w103, ...) of said more ring-shaped focusing structures (101, 102, 103, ...) in a range of 0.6 mm to 0.7 mm;
(iv) a surface-based fill factor (sf101, sf201) defined as a surface area ratio of
- a surface area of an innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...)
and a sum
- of said surface area of said innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...) and an area of a peripheral clear zone (110, 210, ...),

said surface-based fill factor (sf101, sf201) being within a range of larger than 15% and equal to or lower than 60% for said width (w101, w102, w103, ...) of said more ring-shaped focusing structure (101, 102, 103, ...) in a range of 0.5 mm to 0.6 mm;

(v) a surface-based fill factor (sf101, sf201) defined as a surface area ratio of
- a surface area of an innermost ring-shaped focusing structure of said more ring-shaped focusing structures (101, 102, 103, ...)
and a sum
- of said surface area of said innermost ring-shaped focusing structure or said more ring-shaped focusing structures (101, 102, 103, ...) and an area of a peripheral clear zone (110, 210, ...),
said surface-based fill factor (sf101, sf201) being within a range of larger than 6% and equal to or lower than 50% for said width (w101, w102, w103, ...) of said more ring-shaped focusing structures (101, 102, 103, ...) lower than 0.5 mm.

71. Method according to the preceding claim 70, characterized in that said width (w101, w102, w103) is within at least one range selected from the group of ranges consisting of:
(i) said width (w101, w102, w103, ...) is within a range of larger than 0.2 mm and equal to or lower than 0.7 mm;
(ii) said width (w101, w102, w103, ...) is within a range of larger than 0.3 mm and equal to or lower than 0.7 mm;
(iii) said width (w101, w102w, 103, ...) is equal to or lower than 0.6 mm;
(iv) said width (w101, w102, w103, ...) is within a range of larger than 0.2 mm and equal to or lower than 0.6 mm;
(v) said width (w101, w102, w103, ...) is within a range of larger than 0.3 mm and equal to or lower than 0.6 mm;
(vi) said width (w101, w102, w103, ...) is equal to or lower than 0.5 mm;
(vii) said width (w101, w102, w103, ...) is within a range of larger than 0.2 mm and equal to or lower than 0.5 mm;
(viii) said width (w101, w102, w103, ...) is within a range of larger than 0.3 mm and equal to or lower than 0.5 mm.

72. Method according to any one of the preceding claims 70 and 71, characterized in that said central clear zone width (cw110, cw210,...) is within at least one range selected from the group of ranges consisting of:
(i) said central clear zone width (cw110, cw210, cw310, ...) is within a range of larger than 6 mm and equal to or lower than 7 mm;
(ii) said central clear zone width (cw110, cw210, cw310, ...) is within a range of larger than 7 mm and equal to or lower than 9.4 mm.

73. Method according to any one of the preceding claims 70 to 72, characterized in that said at least one ring-shaped focusing structure (101, 102, 103, ...) is providing an additional power (ADD) as

compared to said central clear zone (110, 210, ...) within at least one range selected from the group of ranges consisting of:

(i) said additional power (ADD) is within a range of larger than 6 dioptres and equal to or lower than 12 dioptres;
(ii) said additional power (ADD) is within a range of larger than 7 dioptres and equal to or lower than 11 dioptres;
(iii) said additional power (ADD) is within a range of larger than 8 dioptres and equal to or lower than 10 dioptres.

74. Method for manufacturing a coated lens according to any one of the preceding claims 55 to 57, the coated lens comprising a lens substrate and at least one coating, the method comprising at least the following steps in the given order:

(a) applying said coating composition to at least one of
 - a front surface of said lens substrate, and
 - a back surface of said lens substrate,
(b) applying a surface of a stamp to at least one of
 - said front surface comprising said coating composition,
 - said back surface comprising said coating composition,
 thereby stamping said coating composition between at least one of
 - said front surface and said surface of said stamp, and
 - said back surface and said surface of said stamp,

or

(a') applying said coating composition to a surface of a stamp
(b') applying at least one of a front surface of said lens substrate and a back surface of said lens substrate to said surface of said stamp comprising said coating composition,
 thereby stamping said coating composition between at least one of
 - said front surface and said surface of said stamp,
 - said back surface and said surface of said stamp,
(c) (c') precuring said coating composition resulting in a precured coating,
(d) (d') removing said stamp from said precured coating,
(e) (e') curing said precured coating resulting in said coating,
(f) (f') applying an additional coating composition to said coating,
(g) (g') curing said additional coating composition resulting in an additional coating,

characterized in that

said stamp comprises a surface structured to provide (i) at least one protrusion, (ii) at least one recess, (iii) at least one protrusion and at least one recess to said coating composition.

75. Method for manufacturing a coated lens according to any one of the preceding claims 59 to 62, the coated lens comprising a lens substrate and at least one coating, the method comprising at least the following steps:

(c) applying said first coating composition on at least of

- a front surface of said lens substrate,
- a back surface of said lens substrate,

(d) applying a stamp comprising another coating on at least one of

- said front surface comprising said first coating composition,
- said back surface comprising said first coating composition,

thereby stamping said coating composition and transferring said other coating to said coating composition,

or

(a’) applying said first coating composition on a surface of a stamp, said surface of said stamp comprising another coating,

(b’) applying at least one of a front surface of said lens substrate and a back surface of said lens substrate to said surface of said stamp comprising said second coating composition or said second coating,

thereby stamping said coating composition and transferring said second coating composition or said second coating to said first coating composition,

(c) (c’) curing said first and second coating compositions resulting in a first and second coating,

(d) (d’) removing said stamp from said second coating,

characterized in that

said stamp comprises a surface structured to provide (i) at least one protrusion, (ii) at least one recess, (iii) at least one protrusion and at least one recess to said coating composition.

Figure 1

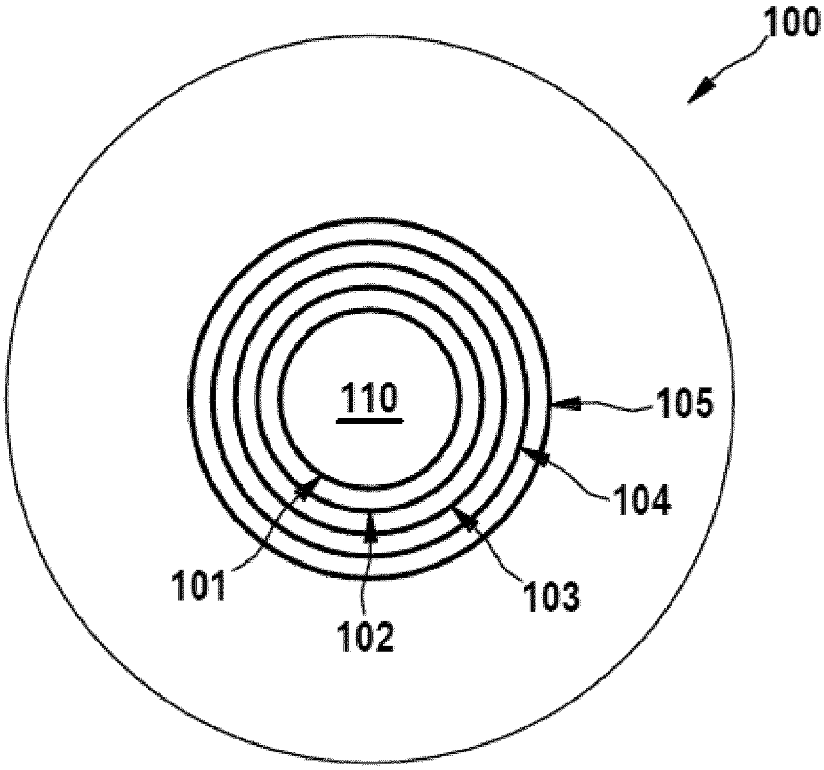

Figure 2

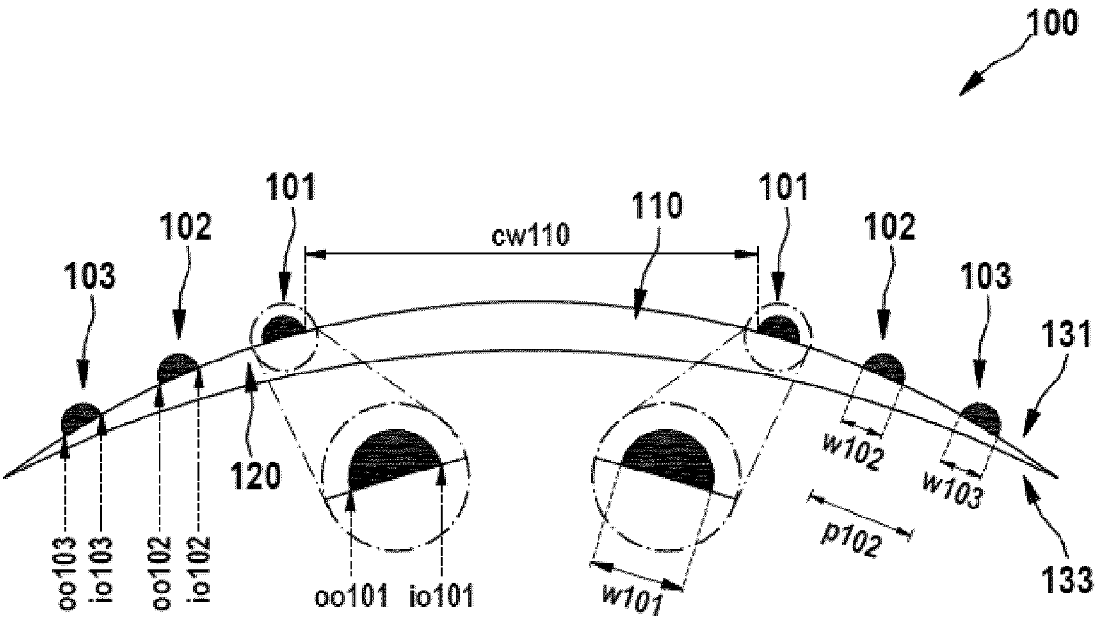

Figure 3