weight, in particular from 5 to 26% by weight, of a styrenic monomer and from 75 to 100% by weight of a (meth)acrylic monomer which forms a homopolymer with a glass transition temperature of from -75 to -5°C. The optionally present second shell comprises a second (meth)acrylic polymer which can be the same as the first (meth)acrylic polymer or can differ therefrom. The total diameter of the core-shell particles or core-shell-shell particles is in the range from 250 to 320 nm.

The core-shell particles or core-shell-shell particles are in turn produced by multistage emulsion polymerization at 80°C, with use of a potassium persulphate as initiator.

The international Patent Application WO 2004/056893 describes efficient processes for the production of core-shell particles or core-shell-shell particles. Core-shell particles or core-shell-shell particles with a total radius of from 150.0 to 250.0 nm are described as particularly suitable for the impact-modification of polyalkyl (meth)acrylate moulding compositions. Minimal amounts of said impact modifiers can give a sufficient improvement in the notched impact resistance of a moulding composition in particular at room temperature, without any simultaneous noticeable impairment of the other significant properties of the moulding composition, in particular modulus of elasticity, melt viscosity, Vicat point and die swell. The resultant moulding compositions have a Charpy notched impact resistance (ISO 179) at 23°C which is preferably at least 6.0 kJ/m^2 and a haze at 23°C in accordance with ASTM D1003 (1997) that is preferably at most 2.5%. However, at 80°C the moulding compositions have markedly poorer haze values, i.e. have visible haze.

However, a fundamental requirement placed upon moulding compositions for products in particular for applications such as lighting and (automobile) glazing is optical clarity even at elevated temperature. Products that are considered to be optically clear here are those with a haze value smaller than or equal to 15.0%, in particular below 10.0% and very particularly below 6.0%, measured by means of a BYK Gardner Hazegard-plus hazemeter in accordance with ASTM D1003 (1997).

It is therefore desirable that the moulding compositions used for the production of lighting and (automobile) glazing exhibit markedly reduced haze increase at elevated temperature. There must therefore be compliance with the requirements placed upon toughness in combination with optical properties such as high transparency with very low haze value even at elevated temperatures. In particular when the products are used in lighting applications with signal colours there should be no shift of colour coordinates due to any increase in haze; this has hitherto limited the use of impact-modified moulding compositions.

It was therefore an object of the embodiments disclosed herein to provide a moulding composition which has high impact resistance and improved haze performance.

Surprisingly, it has been found that the moulding composition according to Claim 1 and the moulded items according to Claim 14, and also the uses according to Claims 16 to 21, achieve this object. Preferred embodiments are listed in the dependent claims.

The Patent provides a moulding composition which comprises, based in each case on its total weight, the following:

I. from 10.0 to 50.0% by weight, preferably from 15.0 to 45.0% by weight, more preferably from 20.0 to 40.0% by weight, of at least one core-shell-shell particle,

II. from 1.0 to 90.0% by weight, preferably from 1.0 to 85.0% by weight, more preferably from 1.0 to 80.0% by weight, of at least one (meth)acrylic polymer,

III. from 0.0 to 45.0% by weight, preferably from 0.0 to 30% by weight, preferably from 0.0 to 10% by weight, of styrene-acrylonitrile copolymers, and

IV. from 0.0 to 10.0% by weight of other additives,

where the percentages by weight of components I. to IV. give a total of 100.0% by weight and where selection of II., or of the mixture of II., III. and/or IV. is such that in a measurement in accordance with ASTM D542 its refractive index differs from the refractive index of I. by no more than 0.01 unit, preferably by no more than 0.002 unit, with preference by no more than 0.001 unit.

The core-shell-shell particle, I., has been produced or is amenable to production by a process in which

a) water and emulsifier are used as initial charge,

b) from 20.0 to 45.0 parts by weight of a first composition, comprising components A), B), C) and D), are added and the mixture is polymerized until conversion is at least 85.0% by weight, based on the total weight of components A), B), C) and D),

c) from 35.0 to 55.0 parts by weight of a second composition, comprising components E), F) and G), are added and the mixture is polymerized until conversion is at least 85.0% by weight, based on the total weight of components E), F) and G),

d) from 10.0 to 30.0 parts by weight of a third composition, comprising components H), I) and J), are added and the mixture is polymerized until conversion is at least 85.0% by weight, based on the total weight of components H), I) and J),

where the stated parts by weight of the compositions b), c) and d) give a total of 100.0 parts by weight.

In an aspect, there is provided a moulding composition comprising respectively, based on its total weight:

I. from 10.0 to 50.0% by weight, preferably from 15.0 to 45.0% by weight, more preferably from 20.0 to 40% by weight, of at least one core-shell-shell particle produced or amenable to production by a process in which

a) water and emulsifier are used as initial charge,

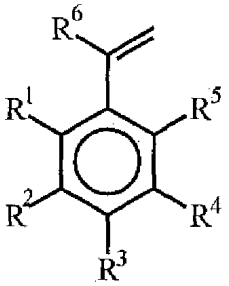
b) from 20.0 to 45.0 parts by weight of a first composition comprising:

A) from 50.0 to 99.9 parts by weight, preferably from 71.0 to 99.9 parts by weight, of alkyl methacrylates having from 1 to 20 carbon atoms in the alkyl moiety,

B) from 0.0 to 40.0 parts by weight, preferably from 0.0 to 29.0 parts by weight, of alkyl acrylates having from 1 to 20 carbon atoms in the alkyl moiety,

C) from 0.1 to 10.0 parts by weight of crosslinking monomers and

D) from 0.0 to 8.0 parts by weight of styrenic monomers of the general formula (I)



(I)

are added, where the moieties R^1 to R^5 respectively mutually independently denote hydrogen, a halogen, a C_{1-6}-alkyl group or a C_{2-6}-alkenyl group and the moiety R^6 is hydrogen or an alkyl group having from 1 to 6 carbon atoms,

and the mixture is polymerized until conversion is at least 85.0% by weight, based on the total weight of components A), B), C) and D),

c) from 35.0 to 55.0 parts by weight of a second composition comprising:

E) from 80.0 to 100.0 parts by weight of (meth)acrylates

F) from 0.05 to 5.0 parts by weight of crosslinking monomers and

G) from 0.0 to 25.0 parts by weight of styrenic monomers of the general formula (I)

are added, and the mixture is polymerized until conversion is at least 85.0% by weight, based on the total weight of components E), F) and G),

d) from 10.0 to 30.0 parts by weight of a third composition comprising:

H) from 50.0 to 100.0 parts by weight of alkyl methacrylates having from 1 to 20 carbon atoms in the alkyl moiety,

I) from 0.0 to 40.0 parts by weight of alkyl acrylates having from 1 to 20 carbon atoms in the alkyl moiety and

J) from 0.0 to 10.0 parts by weight of styrenic monomers of the general formula (I)

are added, and the mixture is polymerized until conversion is at least 85.0% by weight, based on the total weight of components H), I) and J),

where the stated parts by weight of the compositions b), c) and d) give a total of 100.0 parts by weight,

where the relative proportions of all of the substances A) to J) have been selected in such a way as to give core-shell-shell particles with a total radius, measured by the Coulter method, in the range from 70.0 to 125.0 nm, preferably in the range from 85.0 to 110.0 nm, with preference in the range from 90.0 to 105.0 nm;

II. from 1.0 to 90.0% by weight, preferably from 1.0 to 85.0% by weight, more preferably from 1.0 to 80.0% by weight, of at least one (meth)acrylic polymer,

III. from 0.0 to 45% by weight, preferably from 0.0 to 30% by weight, preferably from 0.0 to 10.0% by weight, of styrene-acrylonitrile copolymers, and

IV. from 0.0 to 10.0% by weight of other additives,

where the percentages by weight of components I) to IV) give a total of 100.0% by weight and

where selection of II., or of the mixture of II., III. and/or IV. is such that in a measurement in accordance with ASTM D542 its refractive index differs from the refractive index of I. by no more than 0.01 unit, preferably by no more than 0.002 unit, with preference by no more than 0.001 unit.

In another aspect, there is provided a moulded item obtainable from a moulding composition as defined above.

In another aspect, there is provided use of a moulding composition as defined above for the production of glazing, preferably of glazing of motor vehicles and/or of rail vehicles, or of buildings or machines

In another aspect, there is provided use of a moulded item as defined above as glazing, preferably as glazing of motor vehicles and/or of rail vehicles, or of buildings or machines.

In another aspect, there is provided use of a moulding composition as defined above for the production of displays for communication devices, in particular for PDAs, for mobile telephones, or for cellphones, preferably smartphones; tablet PCs; TV devices; kitchen devices and other electronic devices.

In another aspect, there is provided use of a moulded item as defined above as display for a communication device, in particular a PDA, a mobile telephone, a cellphone, preferably a smartphone; a TV device; a tablet PC; a kitchen device or any other electronic device.

In another aspect, there is provided use of a moulding composition as defined above for the production of lamp covers, preferably for room lighting systems or automobile lighting equipment.

In another aspect, there is provided use of a moulded item as defined above as lamp cover, preferably for room lighting systems or automobile lighting equipment

The progress of the polymerization reaction in each step can be followed in a known manner, for example gravimetrically or by means of gas chromatography.

The process for obtaining I. preferably uses, as initial charge, from 90.00 to 99.99 parts by weight of water and from 0.01 to 10.00 parts by weight of emulsifier, where the stated parts by weight give a total of 100.00 parts by weight.