Patent Claims

1. Star-shaped block copolymer A having:

   two short branches consisting of a single copolymer block $(B/S)_{Ai}$ made from 65 to 95 wt.-% vinylaromatic monomers and 35 to 5 wt.-% dienes and having a glass transition temperature Tg_A in the range from 40 to 90°C, and

   two long branches of the structure S_t-$[(B/S)_A]_n$-$(B/S)_{Ai}$ or $[(B/S)_A]_n$-$(B/S)_{Ai}$, linked by way of the inner blocks $(B/S)_{Ai}$, where the block S_t is made from 95 to 100 wt.-% of vinylaromatic monomers and 0 to 5 wt.-% of dienes; the block $[(B/S)_A]_n$ consists of one or more different or identical copolymer blocks $(B/S)_A$, each made from 65 to 95 wt.-% vinylaromatic monomers and 35 to 5 wt.-% dienes and have a glass transition temperature Tg_A in the range from 40 to 90°C; n is a regular number of at least 1, preferably n = 2 to 10, more preferably n = 2 or 3, most preferably n = 2, and the block $(B/S)_{Ai}$ is as defined above, wherein

   the block $(B/S)_{Ai}$ has a number average molar mass M_n in the range of from 5000 to 15000 g/mol and the entire block $[(B/S)_A]_n$ has a number average molar mass M_n of 50000 to 150000 g/mol.

2. Star shaped block copolymer A according to claim 1 wherein the number-average molar mass Mn of the block S_t is in the range from 3000 to 8000 g/mol.

3. Star shaped block copolymer A according to claim 1 or 2 wherein the copolymer blocks $(B/S)_A$ and $(B/S)_{Ai}$ are composed of polymerized vinylaromatic monomers and of dienes with random distribution.

4. Star shaped block copolymer A according to any of the claims 1 to 3 wherein the block $[(B/S)_A]_n$ consists of 2 to 10, more preferably 2 or 3, most preferably 2 different copolymer blocks $(B/S)_A$, where the blocks $(B/S)_A$ differ in their molar masses and/or in their vinylaromatic/diene ratio.

5. Star shaped block copolymer A according to any of the claims 1 to 4 wherein the number-average molar mass Mn of the copolymer block $(B/S)_{Ai}$ is in the range of from 6000 to 12000 g/mol.

6. Star shaped block copolymer A according to any of the claims 1 to 5 wherein the copolymer blocks $(B/S)_{A,}$ and/or $(B/S)_{Ai}$ are made from 85 to 93 wt.-% of a vinylaromatic monomer, in particular styrene, and from 7 to 15 wt.-% of a diene, in particular isoprene or butadiene.

7. Star shaped block copolymer A according to any of the claims 1 to 6 of the structure:

$$2x\ [S_t\text{-}(B/S)_{A1}\text{-}(B/S)_{A2}\text{-}(B/S)_{Ai}] \quad X \quad 2x\ [(B/S)_{Ai}]$$

where $S_{t,}$ and $(B/S)_{Ai}$ are as defined above, $(B/S)_{A1}$ and $(B/S)_{A2}$ are two different copolymer blocks $(B/S)_A$ as defined above, and X is a coupling center, which is formed by reaction of the living anionic polymer chain with a polyfunctional coupling agent.

8. A process for the preparation of a star shaped block copolymer A according to any of the claims 1 to 7 characterized by:
   a) a double initiation,
   b) a coupling step after the last addition and polymerization of a vinylaromatic monomer and a diene, and
   c) the second initiation process placed before the last addition and polymerization of a vinylaromatic monomer and a diene.

9. Polymer composition comprising components (a) and optionally (b), (c) and (d):

   a) 45 to 100 wt.-% of component a) consisting of:

      a1) 20 to 80 wt.-%, preferably 35 to 65 wt.-%, of at least one star-shaped block copolymer A according to any of the claims 1 to 7, and

      a2) 80 to 20 wt.-%, preferably 65 to 35 wt.-%, of at least one star-shaped block copolymer B, which has

      short branches of structure $S_e\text{-}(B/S)_B$ and at least one, preferably one, long branch of structure $(B/S)_{Ae}\text{-}S_i\text{-}(B/S)_B$, linked by way of the blocks $(B/S)_B$, or

      short branches of structure $S_e\text{-}(B/S)_B\text{-}S_s$ and at least one, preferably one, long branch of structure $(B/S)_{Ae}\text{-}S_i\text{-}(B/S)_B\text{-}S_s$; linked by way of the blocks S_s;

      wherein the polymer blocks S_e and S_i are identical; the polymer blocks S_e, S_i and S_s are made from 95 to 100 wt.-% of vinylaromatic monomers and of from 0 to 5 wt.-% of dienes; the copolymer block $(B/S)_{Ae}$ is made from 65 to 95 wt.-% vinylaromatic monomers and 35 to 5 wt.-% dienes and has a glass transition temperature Tg_A in the range from 40 to 90°C; and the copolymer blocks $(B/S)_B$ are each made from 20 to 60 wt.-% vinylaromatic

monomers and 80 to 40 wt.-% dienes and have a glass transition temperature Tg_B in the range from −80° to 0°C;

wherein the number-average molar mass Mn of the polymer blocks S_e or S_i is in the range from 5000 to 30000 g/mol, Mn of polymer block S_s is lower than 2500 g/mol, Mn of copolymer block $(B/S)_{Ae}$ is in the range from 30000 to 100000 g/mol, and Mn of the copolymer blocks $(B/S)_B$ is in the range of from 5000 to 40000 g/mol;

b) 0 to 55 wt.-% of at least one further thermoplastic polymer other than block copolymers A and B;

c) 0 to 0.8 wt.-% of at least one plasticizer; and

d) 0 to 3 wt.-% of at least one further additive or processing aid different from c);

where the total amount of components (a) and, if appropriate, (b), (c) and (d) is 100% by weight and the glass transition temperature Tg is determined by DSC based on DIN EN ISO 11357-2:2014-07, with evaluation of the 2nd heatling cycle after quick cooling from 180 °C with a heating rate of 20 K/min.

10. Polymer composition according to claim 9 comprising 0.10 to 0.80 wt.-%, preferably 0.15 to 0.70 wt.-%, more preferably 0.20 to 0.60 wt.-% of component c).

11. Polymer composition according to claim 9 or 10, wherein the number-average molar mass Mn of the copolymer block $(B/S)_{Ae}$ of block copolymer B is in the range from 30000 to 100000 g/mol.

12. Polymer composition according to any of the claims 9 to 11 wherein the blocks Se and Si have a number-average molar mass Mn in the range from 5000 to 30000 g/mol.

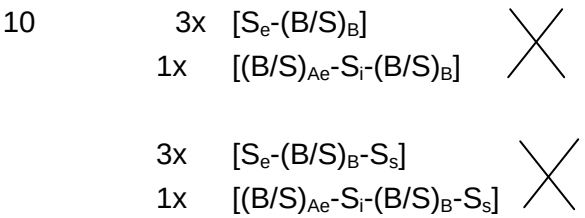
13. Polymer composition according to any of the claims 9 to 12 wherein the number-average molar mass Mn of the copolymer blocks $(B/S)_B$ is in the range of from 5000 to 40000 g/mol.

14. Polymer composition according to any of the claims 9 to 13 wherein the number average molar mass Mn of the block S_s is lower than 2500 g/mol.

15. Polymer composition according to any of the claims 9 to 14 wherein the copolymer blocks $(B/S)_{Ae}$ and $(B/S)_B$ are composed of polymerized vinylaromatic monomers and of dienes with random distribution.

16. Polymer composition according to any of the claims 9 to 15 wherein the proportion of the entirety of all of the blocks $(B/S)_B$ or $(B/S)_B$-S_s of the star-shaped block copolymer B is from 30 to 37 wt.-%, preferably 32 to 36 wt.-%, more preferably 33 to 35 wt.-%, based on the entire star-shaped block copolymer B.

17. Polymer composition according to any of the claims 9 to 16 wherein the star-shaped block copolymers B have the following structures:



where S_e, S_i, S_S, $(B/S)_{Ae}$ and $(B/S)_B$ are as defined above and X is a coupling center, which is formed by reaction of the living anionic polymer chain ends with a polyfunctional coupling agent.

18. Process for the preparation of the polymer composition according to any of claims 9 to 17 by melt mixing of component a) and optional components b), c) and d) by aid of a mixing apparatus, such as a kneader or an extruder, at a temperature in the range of from 160°C to 300°C.

19. Use of the polymer composition according to any of the claims 9 to 17 for the production of films, in particular shrink films.

20. Shrink film, produced from a polymer composition according to any of the claims 9 to 17.