CLAIMS

1. A hair care composition comprising:

silk fibroin fragments having an average weight average molecular weight selected from between about 1 kDa and about 5 kDa, between about 5 kDa and about 10 kDa, between about 6 kDa and about 17 kDa, between about 10 kDa and about 15 kDa, between about 15 kDa and about 20 kDa, between about 17 kDa and about 39 kDa, between about 20 kDa and about 25 kDa, between about 25 kDa and about 30 kDa, between about 30 kDa and about 35 kDa, between about 35 kDa and about 40 kDa, between about 39 kDa and about 80 kDa, between about 40 kDa and about 45 kDa, between about 45 kDa and about 50 kDa, between about 60 kDa and about 100 kDa, and between about 80 kDa and about 144 kDa, and a polydispersity between 1 and about 5;

0 to 500 ppm lithium bromide;

0 to 500 ppm sodium carbonate; and

a dermatologically acceptable carrier.

2. The hair care composition of claim 1, wherein the silk fibroin fragments have a polydispersity between 1 and about 1.5, between about 1.5 and about 2.0, between about 1.5 and about 3.0, between about 2.0 and about 2.5, or between about 2.5 and about 3.0.

3. The hair care composition of claim 1, wherein the silk fibroin fragments are present in the hair care composition at about 0.01 wt. % to about 10.0 wt. %, at about 0.01 wt. % to about 1.0 wt %, at about 1.0 wt. % to about 2.0 wt %, at about 2.0 wt. % to about 3.0 wt %, at about 3.0 wt. % to about 4.0 wt %, at about 4.0 wt. % to about 5.0 wt %, or at about 5.0 wt. % to about 6.0 wt % relative to the total weight of the hair care composition.

4. The hair care composition of claim 1, further comprising about 0.01% (w/w) to about 10% (w/w) sericin relative to the total weight of the hair care composition, or about 0.01% (w/w) to about 10% (w/w) sericin relative to the silk fibroin fragments.

5. The hair care composition of any one of claims 1 to 4, wherein the silk fibroin fragments do not spontaneously or gradually gelate and do not visibly change in color or turbidity when in an aqueous solution for at least 10 days prior to formulation into the hair care composition.

6. The hair care composition of any one of claims 1 to 5, wherein the dermatologically acceptable carrier comprises one or more of an oil phase, an aqueous phase, an oil-in-water emulsion, and/or a water-in-oil emulsion.

7. The hair care composition of claim 1, further comprising an emulsifier, a hydrocarbon oil, a fatty acid, a fatty oil, a fatty acid ester, a cationic quaternary ammonium salt, or any combination thereof.

8. The hair care composition of any one of claims 1 to 7, further comprising a detersive, a detergent, or a combination thereof.

9. The hair care composition of any one of claims 1 to 7, further comprising a hair styling polymer.

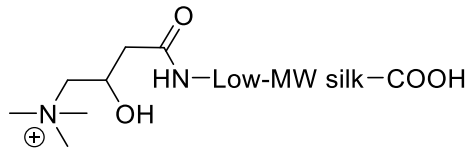
10. The hair care composition of claim 1, wherein the hair care composition is transparent, translucent, or opaque.

11. The hair care composition of any one of claims 1 to 10, wherein the hair care composition is formulated as a hair pre-shampoo product, a hair shampoo product, a hair rinsing product, a hair conditioner product, a hair treatment product, a hair setting lotion product, a blow-styling lotion product, a hair spray product, a hair-styling foam product, a hair-styling gel product, a hair oil product, a hair liquid product, a hair tonic product, a hair cream product, a hair cosmetic product, a permanent waving agent product, a hair mousse product, a hair gel product, hair foam product, a hair paste product, a hair lotion product, a hair wax product, a hair care composition capable of increasing hair sheen, or a hair care composition capable of enhancing hair color.

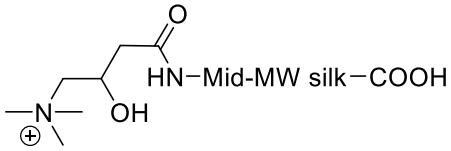
12. A hair care composition capable of foaming comprising the hair care composition of any one of claims 1 to 8, and a surfactant system at less than 20.0 wt. % by the total weight of the hair care composition containing one or more of (a) a sulfate-based surfactant, (b) a silicon-based surfactant, and (c) a synthetic surfactant.

13. A hair dyeing composition comprising the hair care composition of claim 1, wherein the hair dyeing composition capable of coating hair cuticles and managing hair frizz.

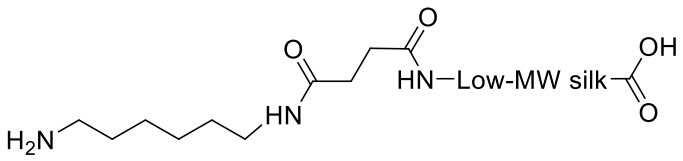
14. Functionalized silk fibroin-based fragments comprising a compound selected from Formulae (1)-(8):



Formula (1),



Formula (2),



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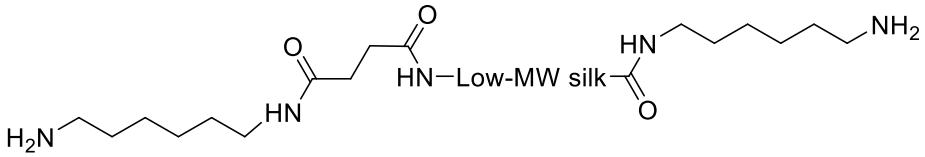

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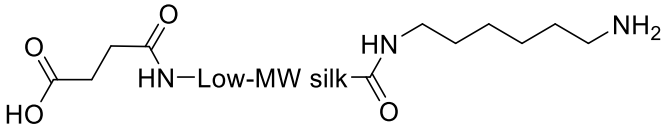

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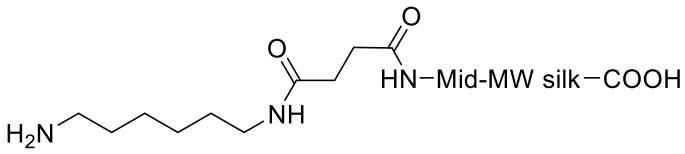

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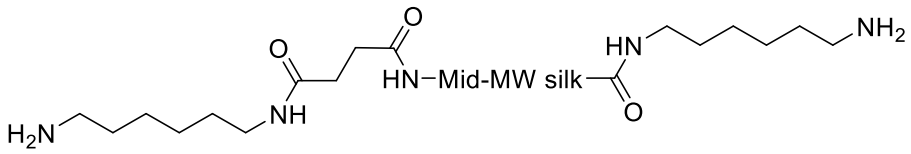

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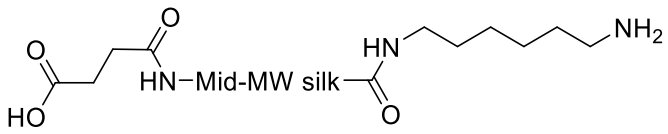

Formula (8),

wherein, the Low-MW silk has a weight average molecular weight ranging from about 5 kDa to about 25 kDa, and a polydispersity ranging from 1.0 to about 5.0,

and the Mid-MW silk has a weight average molecular weight ranging from about 25 kDa to about 60 kDa, and a polydispersity ranging from 1.0 to about 5.0.

15. The functionalized silk of claim 14, wherein the Low-MW silk has a weight average molecular weight ranging from about 5 kDa to about 25 kDa and a polydispersity ranging from about 1.5 to about 3.0.

16. The functionalized silk of claim 14, wherein the Low-MW silk has a weight average molecular weight ranging from about 5 kDa to about 17 kDa and a polydispersity ranging from about 1.5 to about 3.0.

17. The functionalized silk of claim 14, wherein the Mid-MW silk has a weight average molecular weight ranging from about 25 kDa to 60 kDa, and a polydispersity ranging from about 1.5 to about 3.0.

18. The functionalized silk of claim 14, wherein the Mid-MW silk has a weight average molecular weight ranging from about 39 kDa to about 54 kDa, and a polydispersity ranging from about 1.5 to about 3.0.

19. A hair care composition comprising the functionalized silk of any one of claims 14-18.

20. The hair care composition of claim 19, wherein the composition is formulated as a hair care product selected from pre-shampoo products, shampoo products, hair rinses, hair conditioners, hair treatments, setting lotions, blow-styling lotions, hair sprays, hair-styling foams, hair-styling gels, hair oil, hair liquids, hair tonics, hair creams, hair cosmetics, or permanent waving agents.