CLAIMS

1. A polythiol composition comprising sulfur-containing compounds, the sulfur-containing compounds comprising:

   (i) from 50 wt. % to 95 wt. % 5-(2-mercaptoethyl)norbornane-2-thiol and/or 5-(2-mercaptoethyl)norbornane-3-thiol;

   (ii) one or more sulfide molecules having only two thiol sulfur groups (—SH), only one intermolecular sulfide group (—S—), and only two groups independently selected from a 5-(ethyl-2-yl)norborn-2-yl group and a 5-(ethyl-2-yl)norborn-3-yl group; and

   (iii) less than 1 wt. % mono-sulfur compounds;

   wherein the polythiol composition contains less than 1 wt. % 5-vinylnorborn-2-ene.

2. The composition of claim 1, wherein the sulfur-containing compounds further comprise one or more sulfide molecules having only two thiol sulfur groups, only two intermolecular sulfide groups, and only three groups independently selected from a 5-(ethyl-2-yl)norborn-2-yl group and a 5-(ethyl-2-yl)norborn-3-yl group.

3. The composition of claim 1, wherein the sulfur-containing compounds are characterized by:

   an average thiol sulfur to sulfide sulfur molar ratio in a range from 1.5:1 to 1000:1;

   an average of from 0.1 wt. % to 10 wt. % sulfide sulfur;

   an average of from 20 wt. % to 34 wt. % thiol sulfur; and

   a mercaptan equivalent weight in a range from 95 to 150 g/eq.

4. The composition of claim 1, wherein the sulfur-containing compounds are characterized by:

   an average thiol sulfur to sulfide sulfur molar ratio in a range from 2:1 to 40:1;

   an average of from 1 wt. % to 8 wt. % sulfide sulfur; and

   an average of from 22 wt. % to 32 wt. % thiol sulfur.

5. The composition of claim 1, wherein the sulfur-containing compounds contain from 5 wt. % to 35 wt. % intermolecular sulfide compounds.

6. The composition of claim 1, wherein the sulfur-containing compounds have a weight ratio of 5-(2-mercaptoethyl)norbornane-2-thiol and 5-(2-mercaptoethyl)norbornane-3-thiol, in total, to intermolecular sulfide compounds in a range from 1.2:1 to 8:1.

7. An article of manufacture comprising the polythiol composition of claim 1.

8. The article of claim 7, wherein the article further comprises a substrate.

9. The composition of claim 1, wherein the sulfur-containing compounds have an average molar ratio of thiol sulfur to sulfide sulfur in a range from 1.5:1 to 1000:1.

10. The composition of claim 1, wherein:

    the polythiol composition contains less than 0.5 wt. % 5-vinylnorborn-2-ene; and

    the sulfur-containing compounds comprise less than 0.5 wt. % mono-sulfur compounds.

11. The composition of claim 1, wherein:

    the polythiol composition contains less than 0.1 wt. % 5-vinylnorborn-2-ene; and

    the sulfur-containing compounds comprise less than 0.1 wt. % mono-sulfur compounds.

12. The composition of claim 1, wherein the sulfur-containing compounds comprise from 70 wt. % to 90 wt. % 5-(2-mercaptoethyl)norbornane-2-thiol and/or 5-(2-mercaptoethyl)norbornane-3-thiol.

13. The composition of claim 1, wherein the sulfur-containing compounds are characterized by:

    an average of from 1.5 wt. % to 3 wt. % sulfide sulfur; and

    an average of from 27 wt. % to 33 wt. % thiol sulfur.

14. The composition of claim 1, wherein the sulfur-containing compounds have a weight ratio of 5-(2-mercaptoethyl)norbornane-2-thiol and 5-(2-mercaptoethyl)norbornane-3-thiol, in total, to intermolecular sulfide compounds in a range from 1:1 to 10:1.

15. The composition of claim 2, wherein the sulfur-containing compounds contain from 5 wt. % to 35 wt. % intermolecular sulfide compounds.

16. The composition of claim 2, wherein the sulfur-containing compounds contain from 10 wt. % to 30 wt. % intermolecular sulfide compounds.

17. The composition of claim 5, wherein the sulfur-containing compounds contain from 10 wt. % to 30 wt. % intermolecular sulfide compounds.