CLAIMS

What is claimed is:

1. A lubricant composition comprising:

a lubricating oil basestock;

at least one lubricant additive comprising an antioxidant, a corrosion inhibitor, an anti-wear additive, a friction modifier, a dispersant, a detergent, a defoaming agent, an extreme pressure additive, a pour point depressant, a seal-swelling control agent, or a combination thereof; and

a comb copolymer viscosity modifier made by polymerization comprising at least the following monomers:

(a) a hydrogenated polybutadiene-based (alk)acrylate ester macromonomer;

(b) a C_3-C_8 alkyl (alk)acrylate ester monomer;

(c) a C_{12}-C_{24} alkyl (alk)acrylate ester monomer; and

(d) a C_6-C_{20} aryl, aralkyl, or alkaryl (alk)acrylate ester monomer,

but substantially no styrene nor styrenic monomers,

wherein the comb copolymer also comprises substantially no styrene-based nor styrenic-based repeat units,

wherein from 3.0 wt % to 27 wt % of the repeat units of the comb copolymer viscosity modifier are based on the C_6-C_{20} aryl, aralkyl, or alkaryl (alk)acrylate ester monomer, and

wherein a sum of repeat units based on the C_{12}-C_{24} alkyl (alk)acrylate ester monomer plus the C_6-C_{20} aryl, aralkyl, or alkaryl (alk)acrylate ester monomer collectively comprise at least 21.0 wt% of repeat units of the comb copolymer viscosity modifier.

2. The lubricant composition of claim 1, wherein the comb copolymer viscosity modifier comprises substantially no repeat units based on styrene monomer, and wherein repeat units based on the C_{12}-C_{24} alkyl (alk)acrylate ester monomer comprise from 5.0 wt% to 35.0 wt% of repeat units of the comb copolymer viscosity modifier.

3. The lubricant composition of claim 1, wherein repeat units based on the C_{12}-C_{24} alkyl (alk)acrylate ester monomer comprise at least 10.0 wt% of the repeat units of the comb copolymer viscosity modifier, and wherein repeat units based on the C_6-C_{20} aryl, aralkyl, or alkaryl (alk)acrylate ester monomer comprise at least 11.0 wt% of repeat units of the comb copolymer viscosity modifier.

4. The lubricant composition of claim 1, wherein:

(i) repeat units based on the hydrogenated polybutadiene-based (alk)acrylate ester macromonomer comprise from 7.0 wt% to 18 wt% of the repeat units of the comb copolymer viscosity modifier;

(ii) repeat units based on the C_3-C_8 alkyl (alk)acrylate ester monomer comprise from 33 wt% to 64 wt% of the repeat units of the comb copolymer viscosity modifier; or

(iii) both (i) and (ii).

5. The lubricant composition of claim 1, wherein:

(i) the C_3-C_8 alkyl (alk)acrylate ester monomer is a butyl acrylate and/or a butyl methacrylate;

(ii) the C_{12}-C_{24} alkyl (alk)acrylate ester monomer comprises a lauryl acrylate, a lauryl methacrylate, a myristyl acrylate, a myristyl methacrylate, a palmityl acrylate, a palmityl methacrylate, a heptadecanoyl acrylate, a heptadecanoyl methacrylate, or a combination thereof; or

(iii) both (i) and (ii).

6. The lubricant composition of claim 1, wherein the C_6-C_{20} aryl, aralkyl, or alkaryl (alk)acrylate ester monomer comprises a benzyl acrylate, a benzyl methacrylate, a naphthyl acrylate, a naphthyl methacrylate, a phenyl acrylate, a phenyl methacrylate, a toluyl acrylate, a toluyl methacrylate, a phenylethyl acrylate, a phenylethyl methacrylate, a nonylnaphthyl acrylate, a nonylnaphthyl methacrylate, an anthracenyl acrylate, an anthracenyl methacrylate, a phenanthrenyl acrylate, a phenanthrenyl methacrylate, a fluorenyl acrylate, a fluorenyl methacrylate, an ethylfluorenyl acrylate, an ethylfluorenyl methacrylate, or a combination thereof.

7. The lubricant composition of claim 1, comprising from 0.5 mass% to 8.0 mass% of the comb copolymer viscosity modifier, based on the total mass of the lubricant composition.

8. The lubricant composition of claim 1, comprising from 75 mass% to 95 mass% of the lubricating oil basestock, based on the total mass of the lubricant composition, and wherein the lubricating oil basestock comprises a Group I basestock, a Group II basestock, a Group III basestock, or a mixture thereof.

9. The lubricant composition of claim 1, which exhibits:

a non-linear model applied yield stress (APY) value of at most 0.35 Pa and/ora linear model soot rating of at least 25; and

at least three of the following characteristics:

a high-temperature high-shear viscosity at approximately 150°C. (HTHS150) of at least 2.55 cPs;

a high-temperature high-shear viscosity at approximately 100°C. (HTHS100) of at most 5.60 cPs;

a high-temperature high-shear viscosity at approximately 80°C. (HTHS80) of at most 8.30 cPs;

a KV100 from 6.80 cSt to 9.00 cSt;

a kinematic viscosity at approximately 40°C. (KV40) of at most 35.0 cSt;

a kinematic viscosity at approximately 20°C. (KV20) of at most 79.5 cSt; and

a viscosity index of at least 175.

10. The lubricant composition of claim 1, wherein the comb copolymer viscosity modifier comprises at least 23.0 wt% of a sum of repeat units based on the C_{12}-C_{24} alkyl (alk)acrylate ester monomer and of repeat units based on the C_6-C_{20} aryl, aralkyl, or alkaryl (alk)acrylate ester monomer, wherein the comb copolymer viscosity modifier exhibits a weight average molecular weight of less than or equal to 625,000 g/mol, as measured by gel permeation chromatography (GPC) at

about 35°C. in tetrahydrofuran (THF) using polystyrene standards, and
wherein the lubricant composition exhibits:

a non-linear model applied yield stress (APY) value of at most 0.35 Pa and/ora linear model soot rating of at least 25; and

at least four of the following characteristics:

a high-temperature high-shear viscosity at approximately 150°C. (HTHS150) of at least 2.55 cPs;

a high-temperature high-shear viscosity at approximately 100°C. (HTHS100) of at most 5.58 cPs;

a high-temperature high-shear viscosity at approximately 80°C. (HTHS80) of at most 8.25 cPs;

a KV100 from 6.90 cSt to 8.50 cSt;

a kinematic viscosity at approximately 40° C. (KV40) of at most 34.5 cSt;

a kinematic viscosity at approximately 20° C. (KV20) of at most 79.0cSt; and

a viscosity index (VI) of at least 180.

11. The lubricant composition of claim 1, wherein the comb copolymer viscosity modifier is made by polymerization of monomers consisting essentially of:

(a) the hydrogenated polybutadiene-based (alk)acrylate ester macromonomer;

(b) the C_3-C_8 alkyl (alk)acrylate ester monomer;

(c) the C_{12}-C_{24} alkyl (alk)acrylate ester monomer; and

(d) the C_6-C_{20} aryl, aralkyl, or alkaryl (alk)acrylate ester monomer.

12. The lubricant composition of claim 1, wherein the comb copolymer viscosity modifier is made by polymerization comprising monomers (a), (b), (c), (d), and (e) at least one additional olefinic monomer, different from monomers (a), (b), (c), and (d) and which is not a C_1-C_{18} alkyl-endcapped or C_6-C_{20} aryl-, aralkyl-, or alkaryl-endcapped C_2-C_6 oxyalkyl or C_2-C_6 oligo(alkylene glycol)-based (alk)acrylate ester monomer nor a hydroxyalkyl or H-endcapped oligo(alkylene glycol)-based (alk)acrylate monomer.

13. A method of modifying a viscosity and a dispersancy of a lubricant composition comprising:

forming a viscosity and dispersancy modified mixture by combining a viscosity and dispersancy modifying amount of a comb copolymer viscosity modifier with one of the following lubricant composition components:

(1) a lubricating oil basestock comprising at least 75% by weight of one or more basestocks;

(2) at least one lubricant additive comprising an antioxidant, a corrosion inhibitor, an anti-wear additive, a friction modifier, a dispersant, a detergent, a defoaming agent, an extreme pressure additive, a pour point depressant, a seal-swelling control agent, and a combination thereof; or

(3) a lubricant composition comprising both (1) and (2),

the comb copolymer viscosity modifier being made by polymerization comprising at

least the following monomers:

(a) a hydrogenated polybutadiene-based (alk)acrylate ester macromonomer;

(b) a C_3-C_8 alkyl (alk)acrylate ester monomer;

(c) a C_{12}-C_{24} alkyl (alk)acrylate ester monomer; and

(d) a C_6-C_{20} aryl, aralkyl, or alkaryl (alk)acrylate ester monomer, but substantially no styrene nor styrenic monomers,

wherein the comb copolymer also comprises substantially no styrene-based nor styrenic-based repeat units,

wherein from 3.0 wt % to 27 wt % of the repeat units of the comb copolymer viscosity modifier are based on the C_6-C_{20} aryl, aralkyl, or alkaryl (alk)acrylate ester monomer,

wherein a sum of repeat units based on the C_{12}-C_{24} alkyl (alk)acrylate ester monomer plus the C_6-C_{20} aryl, aralkyl, or alkaryl (alk)acrylate ester monomer collectively comprise at least 21.0 wt% of repeat units of the comb copolymer

viscosity modifier, and

wherein the viscosity and dispersancy modified mixture exhibits:

(i) at least a 25% improvement, relative to the lubricant composition components (1), (2), or (3) without the comb copolymer viscosity modifier, with regard to soot dispersancy; and

(ii) at least a 5% difference, relative to the lubricant composition components (1), (2), or (3) without the comb copolymer viscosity modifier, with regard to one or more of HTHS150, HTHS100, HTHS80, KV100, KV40, KV20, and VI.

14. The method of claim 13, wherein the viscosity and dispersancy modifying amount of the comb copolymer viscosity modifier is from 1.0 mass% to 7.0 mass%, based on the total mass of the viscosity modified mixture, and wherein the one or more basestocks comprises a Group I basestock, a Group II basestock, a Group III basestock, or a mixture thereof.

15. The method of claim 13, wherein the comb copolymer viscosity modifier is combined with (1) the lubricating oil basestock, or (3) the lubricant composition comprising (1) and (2) the at least one lubricant additive, and wherein the 25% improvement and 5% difference are thus relative to lubricant composition components (1) or (3).

16. The method of claim 13, wherein the viscosity and dispersancy modified mixture exhibits at least a 33% improvement with regard to a non-linear model applied yield stress measurement of soot dispersancy and at least a 5% difference with regard to four or more of the enumerated viscometric characteristics.

17. The method of claim 13, wherein the viscosity and dispersancy modified mixture exhibits at least a 33% improvement with regard to a linear model soot rating measurement of soot dispersancy and at least a 10% difference with regard to three or more of the enumerated viscometric characteristics.