CLAIMS:

What is claimed is:

1. A lubricant composition comprising an oil and a long chain branched copolymer having:

shear stability index (30 cycles) of from ~~about~~ 2% to ~~about~~ 80%; and

a kinematic viscosity at 100ºC of from ~~about~~ 3 cSt to ~~about~~ 30 cSt,

wherein the copolymer has:

Mw(LS)/Mn(DRI) from ~~about~~ 1.5 to ~~about~~ 6;

a Mw(LS) from ~~about~~ 20,000 to ~~about~~ 600,000 g/mol;

a g'vis of from ~~about~~ 0.7 to ~~about~~ 0.98; and

an ethylene content of ~~about~~ 20 wt.% to ~~about~~ 90 wt. %; and

wherein the copolymer comprises a remant of a metal hydrocabenyl chain transfer agent wherein the metal hydrocarbenyl chain transfer agent is represented by the formula:

$$Al(R')_{3-v}(R'')_v$$

wherein each R', independently, is a C_1-C_{30} hydrocarbyl group; each R'', independently, is a C_4-C_{20} hydrocarbenyl group having an end-vinyl group; and v is from 0.1 to 3.

2. The composition of claim 1, wherein the copolymer has an ethylene content of ~~about~~ 30 wt% to ~~about~~ 80 wt%.

3. The composition of claim 1, wherein the copolymer has an ethylene content of ~~about~~ 40 wt% to ~~about~~ 75 wt%.

4. The composition of claim 1 or 2, wherein the copolymer has an Mw(LS)/Mn(DRI) from ~~about~~ 2.0 to ~~about~~ 5.0.

5. The composition of claim 1 or 2, wherein the kinematic viscosity at 100ºC is from ~~about~~ 6 cSt to ~~about~~ 28 cSt.

6. The composition of claim 1 or 2, wherein the kinematic viscosity at 100ºC is from ~~about~~ 7 cSt to ~~about~~ 25 cSt.

7. The composition of claim 1 or 2, wherein the copolymer has a shear stability index (30 cycles) of ~~about~~ 3% or greater.

8. The composition of claim 1 or 2, wherein the copolymer has a shear stability index (30 cycles) of ~~about~~ 20% or greater.

9. The composition of claim 1 or 2, wherein the copolymer has a shear stability index (30 cycles) of ~~about~~ 30% or greater.

10. The composition of claim 1 or 2, wherein the copolymer has a thickening efficiency of ~~about~~ 1 or greater.

11. The composition of claim 1 or 2, wherein the copolymer has a thickening efficiency of ~~about~~ 1.5 or greater.

12. The composition of claim 1 or 2, wherein the composition comprises ~~about~~ 0.01 wt% to ~~about~~ 20 wt% of the copolymer.

13. The composition of claim 1 or 2, wherein the composition comprises ~~about~~ 0.01 wt% to ~~about~~ 5 wt% of the copolymer.

14. The composition of claim 1 or 2, wherein the oil comprises a hydrocarbon, polyalphaolefin, alkyl esters of dicarboxylic acids, polyglycols, alcohols, polybutenes, alkylbenzenes, organic esters of phosphoric acids, polysilicone oils, or combinations thereof.

15. The composition of claim 1 or 2, wherein the composition has a high temperature, high shear (HTHS) viscosity of ~~about~~ 5 or less.

16. The lubricant composition of claim 1, further comprising at least one of a dispersant, a detergent, an antioxidant, an oiliness improver, as pour point depressant, a friction modifier, a wear modifier, an extreme pressure additive, a defoamer, a demulsifier, or a corrosion inhibitor.

17. The composition of claim 1 or 2, wherein the composition has a second copolymer having an ethylene content less than the ethylene content of the first copolymer and wherein at least one copolymer is a long chain branched copolymer.

18. The composition of claim 1 or 2, wherein the long chain branched ethylene copolymer has a shear thinning ratio greater than 8*EXP(8E-06*w) where w is the Mw(LS) from light scattering GPC-3D.

19. The composition of claim 1 or 2, wherein the copolymer has a Heat of Fusion (J/g) less than 2.2x-110 where x is the wt% ethylene as measured by FTIR.

20. The composition of claim 1 or 2, wherein the copolymer is an ethylene propylene copolymer.

21. The composition of claim 1 or 2 where in the copolymer was made from metal hydrocarbenyl chain transfer agent wherein the metal hydrocarbenyl chain transfer agent is represented by formula:

$$Al(R')_{3-v}(R'')_v$$

wherein each R', independently, is a C_4-C_{10} hydrocarbyl group; each R'', independently, is a C_8-C_{10} hydrocarbenyl group having an end-vinyl group; and v is from 0.1 to 3.

22. The composition of claim 1 or 2 where in the copolymer comprises a remnant of a metal hydrocarbenyl chain transfer agent wherein the metal hydrocarbenyl chain transfer agent is represented by formula:

$$Al(R')_{3-v}(R'')_v$$

wherein each R', independently, is a C_4 hydrocarbyl group; each R'', independently, is a C_{10}

hydrocarbenyl group having an end-vinyl group; and v is from 1 to 3.

23. The composition of claim 1 or 2 where in the copolymer comprises a remnant of a metal hydrocarbenyl chain transfer agent wherein the metal hydrocarbenyl chain transfer agent is represented by formula:

$$Al(R')_{3-v}(R'')_v$$

wherein each R', independently, is a C_4 hydrocarbyl group; each R", independently, is a C_8 hydrocarbenyl group having an end-vinyl group; and v is from 1 to 3.

24. A method of making a lubricant composition comprising:

blending an oil with a long chain branched copolymer, the composition having:

a shear stability index (30 cycles) of from ~~about~~ 2% to ~~about~~ 80%; and

a kinematic viscosity at 100ºC of from ~~about~~ 3 cSt to ~~about~~ 30 cSt, and wherein the copolymer has:

a Mw(LS)/Mn(DRI) from ~~about~~ 1.5 to ~~about~~ 6;

a Mw(LS) from ~~about~~ 20,000 to ~~about~~ 600,000 g/mol;

a g'vis of from ~~about~~ 0.7 to ~~about~~ 0.98; and

an ethylene content of ~~about~~ 20 wt% to ~~about~~ 90 wt%,

and wherein the copolymer comprises a remnant of a metal hydrocarbenyl chain transfer agent wherein the metal hydrocarbenyl chain transfer agent is represented by formula:

$$Al(R')_{3-v}(R'')_v$$

wherein each R', independently, is a C_1-C_{30} hydrocarbyl group; each R", independently, is a C_4-C_{20} hydrocarbenyl group having an end-vinyl group; and v is from 0.1 to 3.

25. A method of lubricating an engine comprising supplying to the engine a lubricant composition comprising an oil and a long chain branched copolymer having:

a shear stability index (30 cycles) of from ~~about~~ 2% to ~~about~~ 80%;

and a kinematic viscosity at 100ºC of from ~~about~~ 3 cSt to ~~about~~ 30 cSt;

wherein the copolymer has: a Mw(LS)/Mn(DRI) from ~~about~~ 1.5 to ~~about~~ 6;

a Mw(LS) from ~~about~~ 20,000 to ~~about~~ 600,000 g/mol;

a g'_{vis} of from ~~about~~ 0.7 to ~~about~~ 0.98;

an ethylene content of ~~about~~ 20 wt% to ~~about~~ 90 wt%; and

wherein the copolymer comprises a remnant of a metal hydrocarbenyl chain transfer agent wherein the metal hydrocarbenyl chain transfer agent is represented by formula:

$$Al(R')_{3-v}(R'')_v$$

wherein each R', independently, is a C_1-C_{30} hydrocarbyl group; each R'', independently, is a C_4-C_{20} hydrocarbenyl group having an end-vinyl group; and v is from 0.1 to 3.