WHAT IS CLAIMED

1. A process for anionic chain transfer polymerization comprising feeding a vinyl aromatic and/or conjugated diene monomer under an atmosphere comprising molecular hydrogen to a reactor vessel containing a reaction mixture of an inert ethereal solvent and an alkali metal or alkali metal alloy.

2. The process of claim 1, wherein said vinyl aromatic monomer is a styrenic monomer.

3. The process of claim 1, wherein the reaction mixture further comprises an electron transfer entraining agent.

4. The process of claim 1, wherein the ethereal solvent and alkali metal or alkali metal alloy are initially charged into the reactor vessel and agitated using high shear mixing to create a dispersion of the initially charged alkali metal or alkali metal alloy.

5. The process of claim 1, wherein the partial pressure of hydrogen is maintained at pressures between 1.0 Bar to 20 Bar.

6. The process of claim 1, wherein the alkali metal alloy is comprised of sodium and potassium.

7. The process of claim 1 wherein the molar ratio of g-atom alkali metal or alkali metal alloy to styrenic monomer is in the range of 1:10 to 1:100.

8. The process of claim 1 where the vinyl aromatic monomer is styrene, the ethereal solvent is tetrahydrofuran and the sodium potassium alloy is NaK_2.

9. The process of claim 1 where the vinyl aromatic monomer is styrene, the ethereal solvent is tetrahydrofuran, the sodium potassium alloy is NaK_2 and the partial pressure of hydrogen is maintained at pressures between 2.5 Bar to 10 Bar .

10. A process for anionic chain transfer polymerization comprising feeding a vinyl aromatic and/or conjugated diene monomer under an atmosphere comprising hydrogen to a reaction mixture in a reactor vessel, wherein said reaction mixture was formed from (a) an organolithium compound; (b) a polytertiaryamine compound; (c) an alkoxide, wherein said

alkoxide is an alkali metal alkoxide, or a magnesium alkoxide; (d) an optional aromatic hydrocarbon an aromatic hydrocarbon having at least one C-H covalent bond pK_a within the range of 2.75 pK_a units above that of the pK_a of toluene to –4.30 pK_a units below the pK_a of toluene; and in (e) a hydrocarbon solvent having a pK_a greater than H_2.

11. The process of claim 10, wherein the process contains an aromatic hydrocarbon having at least one C-H covalent bond pK_a within the range of 2.75 pK_a units above that of the pK_a of toluene to –4.30 pK_a units below the pK_a of toluene, and wherein the aromatic hydrocarbon and hydrocarbon solvent may be the same or different.

12. The process of claim 10, wherein the alkoxide is potassium or sodium alkoxide.

13. The process of claim 10, wherein said vinyl aromatic monomer is a styrenic monomer.

14. The process of claim 10, wherein the organolithium compound is *n*-butyllithium, *sec*-butyllithium, *tert*-butyllithium, *iso*-butyllithium, phenyllithium, 1-hexyl-1-phenyllithium, cyclohexyllithium or poly(styryl)lithium.

15. The process of claim 10, wherein the polytertiaryamine is *N,N,N',N'*-tetramethylethylenediamine (TMEDA).

16. The process of claim 10, wherein the alkoxide is an alkoxides derived from *t*-butylalcohol [$(CH_3)_3COH$], *t*-pentylalcohol [$C_2H_5(CH_3)_2COH$] or 3-methyl-*t*-pentylalcohol [$CH_3(C_2H_5)_2COH$].

17. The process of claim 10, wherein the aromatic hydrocarbon is benzene, toluene, mesitylene, *o*-xylene, *m*-xylene, ethylbenzene, *n*-propylbenzene, *n*-butylbenzene, isobutylbenzene, amylbenzene, 1,3-diarylpropanes or a styrene dimer.

18. The process of claim 10, wherein the partial pressure of hydrogen is maintained at pressures between 1.0 Bar to 19.0 Bar.

19. The process of claim 10, wherein the molar ratio of the alkoxide to organolithium compound charged in the reactor is in the range of 0.25:1 to 10:1; the molar ratio of styrene to organolithium compound is 10:1 to 1000:1, and the molar ratio of the tertiary amine to

organolithium compound is in the range of 1.5:1 to 20:1 and the hourly feed rate of monomer to organolithium is in the range of 10 to 200 moles of monomer per hour per mole of organolithium.

20. The process of claim 10 conducted where the vinyl aromatic monomer is styrene, the organolithium compound is a butyllithium, the polytertiaryamine is *N,N,N',N'*-tetramethylethylenediamine (TMEDA) and the hydrocarbon is ethylbenzene.

21. A polystyrene polymer composition formed exclusively from styrene and molecular hydrogen as the monomers and made from the process of claim 1 or 10 wherein the GPC molecular weight distribution is characterized where M_n is in the range of from 315 to 905 Daltons; M_w is in the range of from 392 to 1716 Daltons; and M_z is in the range of 512 to 3031 Daltons; PD_n is in the range of 1.24 to 1.90; with a standard deviation in the range of 156 to 857 Daltons and the asymmetry is in the range of 1.40 to 3.14.

22. The polystyrene polymer composition of claim 21 wherein the GPC molecular weight distribution is characterized where M_n is in the range of from 410 to 680 Daltons; M_w is in the range of from 553 to 1205 Daltons; and M_z is in the range of 745 to 1950 Daltons; PD_n is in the range of 1.29 to 1.82; with a standard deviation in the range of 257 to 600 Daltons and the asymmetry is in the range of 1.50 to 2.60.

23. The polystyrene polymer composition of claim 21 wherein the GPC molecular weight distribution is characterized where M_n is in the range of from 444 to 683 Daltons; M_w is in the range of from 600 to 1150 Daltons; and M_z is in the range of 798 to 1768 Daltons; PD_n is in the range of 1.35 to 1.68; with a standard deviation in the range of 263 to 565 Daltons and the asymmetry is in the range of 1.50 to 2.31.

24. A hydrocarbon soluble catalytic composition formed from: (a) molecular hydrogen; (b) an organolithium compound; (c) a polytertiaryamine compound; (d) an alkoxide, wherein said alkoxide is an alkali metal alkoxide, or a magnesium alkoxide; (e) an aromatic hydrocarbon having at least one C-H covalent bond pK_a within the range of 2.75 pK_a units above that of the pK_a of toluene to –4.30 pK_a units below the pK_a of toluene; and (f) a hydrocarbon solvent; wherein the aromatic hydrocarbon and hydrocarbon solvent may be the same or different.

25. The composition of claim 24, wherein the alkoxide is a potassium and/or sodium alkoxide.

26. The composition of claim 24, wherein the organolithium compound is *n*-butyllithium, *sec*-butyllithium, *tert*-butyllithium, *iso*-butyllithium, phenyllithium, 1-hexyl-1-phenyllithium, cyclohexyllithium or poly(styryl)lithium.

27. The composition of claim 24, wherein the tertiary amine is *N,N,N',N'*-tetramethylethylenediamine (TMEDA).

28. The composition of claim 24, wherein the alkoxide is an alkoxide derived from *t*-butylalcohol [$(CH_3)_3COH$], *t*-pentylalcohol [$C_2H_5(CH_3)_2COH$] or 3-methyl-*t*-pentylalcohol [$CH_3(C_2H_5)_2COH$].

29. The composition of claim 24, wherein the aromatic hydrocarbon is benzene, toluene, *o*-xylene, *m*-xylene, mesitylene, ethylbenzene, *n*-propylbenzene, *n*-butylbenzene, isobutylbenzene, amylbenzene, 1,3-diarylpropanes or styrene dimer.

30. The composition of claim 24, wherein the molar ratio of the alkoxide to organolithium compound is in the range of 0.25:1 to 10:1; and the molar ratio of the polytertiaryamine to organolithium compound is in the range of 1.5:1 to 20:1 and wherein the partial pressure of hydrogen is maintained at pressures between 1.0 Bar to 19 Bar.