What is claimed is:

1. A process for producing a poly(methacrylic acid) having a weight average molecular weight of at least 200,000 Daltons, comprising the steps of:
   (1) obtaining a water-based polymerization composition which comprises
      (a) methacrylic acid in an amount of from ~~about~~ 1% to ~~about~~ 20% by weight relative to the water-based polymerizable composition,
      (b) at least one azo-containing radical initiator which has a water solubility of at least 0.05 gram per 100 g of water at 25±3°C and a 10-hour half life temperature of from ~~about~~ 40°C to ~~about~~ 90°C,
      (c) a thiol-containing compound as a chain-transferring agent, and
      (d) water,
      wherein the water-based polymerizable composition has a pH of from ~~about~~ 3.0 to ~~about~~ 4.5,
      wherein the mole ratio of component (a) to component (b) is at least ~~about~~ 800 while the molar ratio of component (b) to component (c) is from ~~about~~ 1 to ~~about~~ 3.0; and
   (2) thermally polymerizing methacrylic acid in the water-based polymerizable composition at a temperature of from ~~about~~ 40°C to ~~about~~ 90°C to obtain the poly(methacrylic acid).
2. The process of claim 1, wherein the methacrylic acid is present in the water-based polymerizable composition in an amount of from ~~about~~ 1.5% to ~~about~~ 15% ~~(preferably from about 2% to about 10%, more preferably from about 3% to about 8%)~~ by weight relative to the water-based polymerizable composition.
3. The process of claim 1 or 2, wherein said at least one azo-containing radical initiator has a 10-hour half-life temperature of from ~~about~~ 40°C to ~~about~~ 80°C.
4. The process of claim 1 or 2, wherein said at least one azo-containing radical initiator has a 10-hour half-life temperature of from ~~about~~ 40°C to ~~about~~ 70°C.
5. The process of claim 1 or 2, wherein said at least one azo-containing radical initiator has a 10-hour half-life temperature of from ~~about~~ 40°C to ~~about~~ 65°C.
6. The process of any one of claims 1 to 5, wherein the water-based polymerizable composition has a pH of from ~~about~~ 3.0 to ~~about~~ 4.2.
7. The process of any one of claims 1 to 5, wherein the water-based polymerizable composition has a pH of from ~~about~~ 3.0 to ~~about~~ 3.7.
8. The process of any one of claims 1 to 7, wherein the mole ratio of component (a) to component (b) is at least 2000.
9. The process of any one of claims 1 to 7, wherein the mole ratio of component (a) to component (b) is at least 2500 ~~(preferably at least 3000)~~.

10. The process of any one of claims 1 to 9, wherein the molar ratio of component (b) to component (c) is from ~~about~~ 1.05 to ~~about~~ 2.5.
11. The process of any one of claims 1 to 9, wherein the molar ratio of component (b) to component (c) is from ~~about~~ 1.1 to ~~about~~ 2.0~~, preferably from about 1.15 to about 1.5~~.
12. The process of any one of claims 1 to 11, wherein the step of thermally polymerizing is carried out at a temperature of from ~~about~~ 40°C to ~~about~~ 80°C ~~(preferably from about 40°C to about 70°C, more preferably from about 40°C to about 65°C)~~.
13. The process of any one of claims 1 to 12, wherein the thio-containing compound is selected from the group consisting of 2-mercaptoethylamine, 2-mercaptopropylamine, 3-mercaptopropylamine, 2-mercaptobutylamine, 3-mercaptobutylamine, 4-mercaptobutylamine, 1-amino-2-methyl-2-propanethiol hydrochloride, N-methylaminoethanethiol, N-ethylaminoethanethiol, N-methylaminopropanethiol, N-ethylaminopropanethiol, N-methylaminobutanethiol, N-ethylaminobutanethiol, 2-(butylamino)ethanethiol, thioglycolic acid, ammonium thioglycolate, thiolactic acid, mercaptosuccinic acid, 2-mercaptoisobutyric acid, 2-methyl-3-sulfanylpropanoic acid, 4-mercaptobutyric acid, 6-mercaptohexanoic acid, 2-mercaptoethanol, 1-mercapto-2-propanol, 1-thioglycerol, 3-mercapto-1-propanol, 4-mercapto-1-butanol, 3-mercapto-1-hexanol, 4-mercapto-4-methylpentan-2-ol, cysteine; 4-amino-5-mercapto-pentanoic acid, 3-mercapto-2-(methylamino)propanoic acid, and combinations thereof.
14. The process of any one of claims 1 to 12, wherein the thio-containing compound is 2-mercaptoethylamine.
15. The process of any one of claims 1 to 14, wherein the pH is achieved by adding a base selected from the group consisting of NaOH, NH_4OH, KOH, and combinations thereof.
16. The process of any one of claims 1 to 15, wherein the pH is achieved by adding KOH.
17. ~~A poly(methacrylic acid) obtained according to a process of any one of claims 1 to 16.~~
18. ~~A poly(methacrylic acid), having: a weight average molecular weight of at least 400,000 Daltons (preferably at least 600,00 Daltons, more preferably at least 800,000 Daltons, even more preferalby at least 1,000,000 Daltons), a polydispersity index (PDI) of from about 2.0 to about 3.0 (preferably from about 2.0 to about 2.8, more preferably from about 2.0 to about 2.6), and a substituted-alkylthio group of –S–R at an end terminal, wherein R is a linear or branched C_2-C_{10}-alkyl group including one or two functional groups selected from the group consisting of –OH, –COOH, $–NH_2$, $–NHCH_3$, $–NHC_2H_5$, and combinations thereof.~~