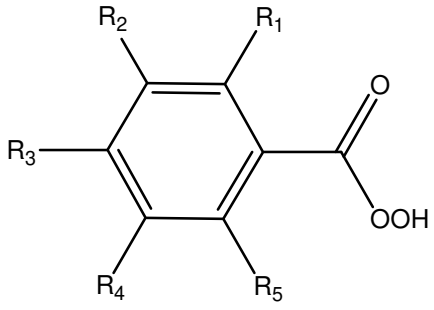
Claims:

1. A process for epoxidation of an unsaturated polymer, the process comprising mixing a solid unsaturated polymer and a peroxy acid in an absence of solvent to produce an epoxidized polymer, wherein the unsaturated polymer comprises a copolymer comprising repeating units derived from at least one isoolefin monomer and repeating units derived from at least one multiolefin monomer.

2. The process according to claim 1, wherein the unsaturated polymer is mixed with the peroxy acid in an absence of a catalyst.

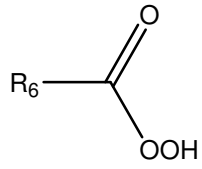
3. The process according to claim 1, wherein the peroxy acid is a compound of formula (I):



(I)

where R_1, R_2, R_3, R_4 and R_5 are independently hydrogen, methyl, ethyl, phenyl, chloro or bromo.

4. The process according to claim 1, wherein the peroxy acid comprises *m*-chloroperoxybenzoic acid and/or a compound of formula (II):



(II)

where R_6 is hydrogen, methyl, ethyl, propyl, butyl, pentyl or hexyl.

5. The process according to claim 1, wherein the unsaturated polymer is mixed with the peroxy acid at a temperature of ambient temperature to about 95°C.

6. The process according to claim 1, wherein the unsaturated polymer is mixed with the peroxy acid for less than about 1 hour.

7. The process according to claim 1, wherein the copolymer is an unsaturated elastomer.

8. The process according to claim 1, wherein the copolymer is a non-halogenated or halogenated butyl rubber.

9. The process according to claim 1, wherein the at least one isoolefin monomer comprises isobutane.

10. The process according to claim 1, wherein the at least one multiolefin monomer comprises isoprene.

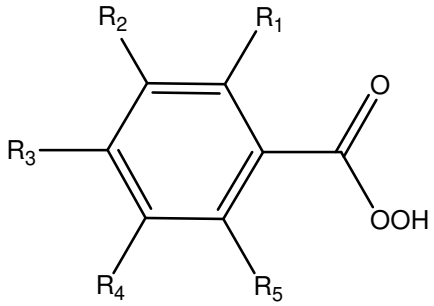
11. A process for epoxidation of an unsaturated polymer, the process comprising: mixing an unsaturated polymer and a peroxy acid in an absence of solvent to produce an epoxidized polymer, wherein the peroxy acid is supported on a matrix comprising a saturated polymer.

12. The process according to claim 11, wherein the saturated polymer comprises polyisobutylene.

13. The process according to claim 11, wherein the unsaturated polymer comprises an unsaturated isoolefin copolymer, a styrene-butadiene rubber, a polybutadiene rubber, a natural polyisoprene, a synthetic polyisoprene, a butadiene-acrylonitrile copolymer, an ethylene propylene diene monomer (EPDM) copolymer, halogenated polymers thereof or mixtures thereof.

14. The process according to claim 11, wherein the unsaturated polymer comprises a copolymer comprising repeating units derived from at least one isoolefin monomer and repeating units derived from at least one multiolefin monomer.

15. The process according to claim 11, wherein:
the peroxy acid is a compound of formula (I):



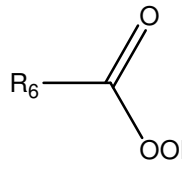
(I)

where R_1, R_2, R_3, R_4 and R_5 are independently hydrogen, methyl, ethyl, phenyl, chloro or bromo; and the unsaturated polymer comprises an unsaturated elastomer.

16. The process according to claim 15, wherein the unsaturated elastomer is selected from the group consisting of:

a copolymer comprising repeating units derived from at least one isoolefin monomer and repeating units derived from at least one multiolefin monomer, an unsaturated isoolefin copolymer, a styrene-butadiene rubber, a polybutadiene rubber, a natural polyisoprene, a synthetic polyisoprene, a butadiene-acrylonitrile copolymer, an ethylene propylene diene monomer (EPDM) copolymer, halogenated polymers thereof and mixtures thereof.

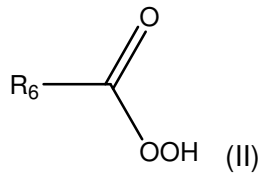
17. A process for epoxidation of an unsaturated polymer, the process comprising mixing an unsaturated polymer and a peroxy acid in an absence of solvent to produce an epoxidized polymer; wherein the peroxy acid comprises m-chloroperoxybenzoic acid and/or a compound of formula (II):



(II)

where R6 is hydrogen, methyl, ethyl, propyl, butyl, pentyl or hexyl; and
the peroxy acid is supported on a matrix comprising a saturated polymer.

18. The process according to claim 17, wherein:
the peroxy acid comprises *m*-chloroperoxybenzoic acid and/or a compound of formula (II):



(II)

where R_6 is methyl;

the peroxy acid is supported on a matrix comprising polyisobutylene;

the unsaturated polymer is a non-halogenated or halogenated butyl rubber; and

the unsaturated polymer is mixed with the peroxy acid in an absence of a catalyst.

19. The process according to claim 18, wherein the unsaturated polymer is mixed with the peroxy acid at a temperature of ambient temperature to about 50°C, and for a period of time less than about 0.5 hour.

20. The process according to claim 19, wherein the unsaturated polymer is mixed with the peroxy acid at ambient temperature in an absence of externally applied heating, and for a period of time of about 10 minutes or less.