CLAIMS

1. A polyolefin composite comprising

a matrix comprising a polyolefin, a polymer having a moiety grafted thereon, and a polymerisable epoxide linker, wherein the moiety grafted on the polymer is covalently bonded to the polymerisable epoxide linker via a chemical bond, wherein the polymerisable epoxide linker is derived from a polymerisable epoxide resin obtained by a reaction between an amine and an epoxide-containing precursor, wherein the amine is selected from the group consisting of tetraglycidyldiaminodiphenylmethane, aminophenol, aminocresol, xylenediamine, and a combination thereof, and

a filler disposed within the matrix.

2. The polyolefin composite of claim 1, wherein the polyolefin is selected from the group consisting of a polymer or a random copolymer or a block copolymer of a C_{2-20}alkylene, a C_{4-20}alkyldiene, a C_{6-20}alkyltriene, a C_{3-20}cycloalkylene, a C_{4-20}cycloalkyldiene, a C_{5-20}cycloalkyltriene, a C_{8-20}phenylalkylene, and a combination thereof, optionally from a polymer or a random copolymer or a block copolymer of ethylene, propylene, 1-pentene, 1-butene, 4-methyl-1-pentene, 1-hexene, 1-octene, 1-decene, styrene, ethylidene norbornene, 1,4-hexadiene, 1,5-hexadiene, 1,7-octadiene, 1,9-decadiene, dicyclopentadiene and ethylene-propylene-diene monomer.

3. The polyolefin composite of claim 1 or 2, wherein the polyolefin is polyethylene.

4. The polyolefin composite of claim 1 or 2, wherein the polyolefin is polypropylene, optionally in a combination with an ethylene-α-olefin copolymer.

5. The polyolefin composite of any one of the preceding claims, wherein the polyolefin has a melt flow rate of ~~about~~ 5 g/10 min to 100 g/10 min, optionally of ~~about~~ 5 g/10 min to 50 g/10 min at a temperature of 230 °C and at a weight of 2.16 kg.

6. The polyolefin composite of any one of the preceding claims, wherein the polyolefin is present in a weight percentage range of ~~about~~ 30wt% to ~~about~~ 95wt%, or of ~~about~~ 40wt%

to about 95wt%, or of about 50wt% to about 95wt%, or of about 50wt% to about 90wt%, or of about 50wt% to about 80wt%, or of about 50wt% to about 70wt%, based on the total weight of the polyolefin composite.

7. The polyolefin composite of any one of the preceding claims, wherein the polymer having a moiety grafted thereon is a further polyolefin having a moiety grafted thereon.

8. The polyolefin composite of claim 7, wherein the further polyolefin is selected from the group consisting of a polymer or a random copolymer or a block copolymer of a C_{2-20}alkylene, a C_{4-20}alkyldiene, a C_{6-20}alkyltriene, a C_{3-20}cycloalkylene, a C_{4-20}cycloalkyldiene, a C_{5-20}cycloalkyltriene, a C_{8-20}phenylalkylene, and a combination thereof, optionally from a polymer or a random copolymer or a block copolymer of ethylene, propylene, 1-pentene, 1-butene, 4-methyl-1-pentene, 1-hexene, 1-octene, 1-decene, styrene, ethylidene norbornene, 1,4-hexadiene, 1,5-hexadiene, 1,7-octadiene, 1,9-decadiene, dicyclopentadiene and ethylene-propylene-diene monomer.

9. The polyolefin composite of claim 7 or 8, wherein the further polyolefin is polypropylene.

10. The polyolefin composite of any one of the preceding claims, wherein the polymer having a moiety grafted thereon is present in a weight percentage range of up to about 50wt%, or between about 0.1wt% and about 50wt%, or between about 0.001wt% and about 30wt%, or between about 0.1wt% and about 40wt%, or between about 0.1wt% and about 20wt%, or of about 5wt%, or of about 10wt%, based on the total weight of the polyolefin composite.

11. The polyolefin composite of any one of the preceding claims, wherein the polymer having a moiety grafted thereon is present in a weight percentage range of up to about 10wt%, or between about 0.1wt% and about 10wt%, or between about 4wt% and about 10wt%, based on the total weight of the polyolefin composite.

12. The polyolefin composite of any one of the preceding claims, wherein the moiety grafted on the polymer comprises a –COO- group which forms the chemical bond with the polymerizable epoxide linker.

13. The polyolefin composite of claim 12, wherein the moiety comprising the –COO- group of the polymer is derived from an anhydride selected from the group consisting of maleic anhydride, succinic anhydride, citraconic anhydride, endo-bi-cyclo[2,2,1]-1,4,5,6,7,7-hexa-chloro-5 heptene-2,3-dicarboxylic acid anhydride, endo-bi-cyclo[2,2,1]-5-heptene-2,3-dicarboxylic acid anhydride, cis-4-cyclohexene-1,2-dicarboxylic acid anhydride, and a combination thereof.

14. The polyolefin composite of claim 12 or 13, wherein the moiety comprising the –COO- group of the polymer is derived from maleic anhydride.

15. The polyolefin composite of any one of the preceding claims, wherein the polymer further comprises a functional group selected from the group consisting of a hydroxyl, a carboxylic acid, a carboxylate, methyl acrylate, methyl methacrylate, ethyl acrylate, ethyl methacrylate, butyl acrylate, butyl methacrylate, maleate monoester, maleate diester, and a combination thereof.

16. The polyolefin composite of any one of the preceding claims, wherein the polymerisable epoxide linker is present in a weight percentage range of up to ~~about~~ 50wt%, or between ~~about~~ 0.1wt% and ~~about~~ 50wt%, or of up to ~~about~~ 10wt%, or between ~~about~~ 0.1wt% and ~~about~~ 10wt%, or between ~~about~~ 3wt% and ~~about~~ 15wt%, based on the total weight of the polyolefin composite.

~~17. The polyolefin composite of any one of the preceding claims, wherein the polymerisable linker is a polymerisable epoxide linker.~~

~~18. The polyolefin composite of any one of the preceding claims, wherein the polymerisable linker is derived from a polymerisable resin, optionally selected from the group consisting of an epoxy-containing monomer, oligomer, polymer and a combination thereof.~~

~~19. The polyolefin composite of claim 18, wherein the polymerisable resin is selected from the group consisting of bisphenol A epoxy resin, bisphenol S epoxy resin, bisphenol K epoxy resin, bisphenol F epoxy resin, phenolic novolak epoxy resin, cresol novolak epoxy resin, acyclic epoxy resin, heterocyclic epoxy resin, hydrogenated bisphenol A epoxy resin, aliphatic epoxy resin, and a combination thereof.~~

~~20. The polyolefin composite of claim 18, wherein the polymerisable resin is obtained by a reaction between an aromatic, aliphatic or alicyclic carboxylic acid and an epoxide-containing precursor.~~

~~21. The polyolefin composite of claim 18, wherein the polymerisable resin is a glycidyl ether epoxy resin which is obtained by a reaction between ortho-allyl phenolic novolak and an epoxide-containing precursor; or by a reaction between a diallyl bisphenol compound having an allyl group in the *ortho* position of bisphenol A with respect to the hydroxyl group and an epoxide-containing precursor; or by a reaction between trishydroxylmethane and an epoxide-containing precursor.~~

~~22. The polyolefin composite of claim 18, wherein the polymerisable resin is obtained by a reaction between a phenol derivative and an epoxide-containing precursor, wherein the phenol derivative is selected from the group consisting of bisphenol, resorcinol, dihydroxynaphthalene, trihydroxynaphthalene, dihydroxybiphenylfluorene, tetrakishydroxphenlylethane, novolaks, a condensate of dicyclopentadiene, phenol, and a combination thereof.~~

~~23. The polyolefin composite of claim 18, wherein the polymerisable resin is obtained by a reaction between an amine and an epoxide-containing precursor, wherein the amine is selected from the group consisting of tetraglycidyldiaminodiphenylmethane, aminophenol, aminocresol, xylenediamine, and a combination thereof.~~

~~24~~17. The polyolefin composite of any one of the claims ~~20~~1 to ~~23~~16, wherein the epoxide-containing precursor is selected from the group consisting of epichlorohydrin, ethylene oxide,

propylene oxide, styrene oxide, cyclohexene oxide, phenyl glycidyl ether, and a combination thereof.

~~25~~18. The polyolefin composite of any one of claims 1 to ~~18~~17, wherein the polymerisable epoxide resin comprises a spiro ring.

~~26~~19. The polyolefin composite of any one of the preceding claims, wherein the chemical bond is an ester bond.

~~27~~20. The polyolefin composite of any one of the preceding claims, wherein the filler is present in a weight percentage range of ~~about~~ 1wt% to ~~about~~ 70wt%, optionally of ~~about~~ 5wt% to ~~about~~ 30wt%, optionally of ~~about~~ 10wt% to ~~about~~ 30wt%, optionally of ~~about~~ 10wt% to ~~about~~ 50wt%, optionally of ~~about~~ 10wt% to ~~about~~ 20wt% based on the total weight of the polyolefin composite.

~~28~~21. The polyolefin composite of any one of the preceding claims, wherein the filler has a size of ~~about~~ 0.1 µm to ~~about~~ 50 mm.

~~29~~22. The polyolefin composite of any one of the preceding claims, wherein a material of the filler is selected from the group consisting of clay, glass, carbon, cellulose, and a combination thereof.

~~30~~23. The polyolefin composite of claim ~~29~~22, wherein the material of the filler is glass and is present as glass roving, glass chopped strand, glass milled fiber, or a combination thereof.

~~31~~24. The polyolefin composite of claim ~~29~~22 or ~~30~~23, wherein the material of the filler is glass and is surface-treated with an organosilane, thereby enabling hydrogen bonding and/or a covalent bond between the filler and the polymerisable epoxide linker.

~~32~~25. The polyolefin composite of claim ~~31~~24, wherein the organosilane comprises an active functional group selected from the group consisting of octyl, amine, vinyl, hydroxyl, thiol, and a combination thereof.

~~33~~26. The polyolefin composite of claim ~~31~~24 or ~~32~~25, wherein the organosilane is selected from the group consisting of aminopropyltrimethoxysilane, γ-aminopropylmethyldimethoxysilane, γ-aminopropyltriethoxysilane, γ-aminopropylmethyldiethoxysilane, γ-(N,N-dimethyl)aminopropyltrimethoxysilane, γ-(N,N-diethyl)aminopropyltrimethoxysilane, γ-(N,N-dibutyl)aminopropyltrimethoxysilane, γ-(N,N-dimethyl)aminopropyltriethoxysilane, γ-(N,N-diethyl)aminopropyltriethoxysilane, γ-(N,N-dibutyl)aminopropyltriethoxysilane, γ-(N-methyl)aminopropyltriethoxysilane, γ-(N-ethyl)aminopropyltriethoxysilane, γ-(N,N-dimethyl)aminopropylmethyldimethoxysilane, γ-(N,N-diethyl)aminopropylmethyldimethoxysilane, γ-(N,N-dibutyl)aminopropylmethyldimethoxysilane, γ-(N-methyl)aminopropylmethyldimethoxysilane, and a combination thereof.

~~34~~27. The polyolefin composite of any one of the claims ~~31~~24 to ~~33~~26, wherein the organosilane is present in a weight percentage range of ~~about~~ 0.1wt% to ~~about~~ 5wt%, based on the weight of the filler.

~~35~~28. The polyolefin composite of claim ~~29~~22, wherein the material of the filler is clay and is selected from the group consisting of inorganic silicate, alumino silicate, pellet-like metal oxide and hydroxide, anionic and cationic layered metal oxide and hydroxide, montmorillonite (MMT), kaolinite, dickite, halloysite, and nacrite, nontronite, beidellite, saponite, illite, biotite, lepidolite, phlogopite, clintonite, sepiolite, zinnwaldite, phengite, mica, layered metal oxide, layered metal hydroxide, attapulgite (AT), and a combination thereof.

~~36~~29. The polyolefin composite of claim ~~35~~28, wherein the inorganic silicate is calcium silicate.

~~37~~30. The polyolefin composite of claim ~~35~~28 or ~~36~~29, wherein the clay comprises layered and/or pellet-like metal oxide.

~~38~~31. The polyolefin composite of claim ~~37~~30, wherein the layered and/or pellet-like metal oxide is selected from the group consisting of SiO_2, TiO_2, ZnO, CaO, Al_2O_3, Fe_2O_3, and a combination thereof.

~~39~~32. The polyolefin composite of any one of the preceding claims, further comprising a stabilizer selected from the group consisting of an antioxidant, an ultraviolet ray absorber, and a combination thereof.

~~40~~33. The polyolefin composite of claim ~~39~~32, wherein the stabilizer is selected from the group consisting of a hindered phenol, a phosphite, a thioether, a benzophenone, a benzotriazole, and a combination thereof.

~~41~~34. The polyolefin composite of claim ~~39~~32, wherein the antioxidant is present in a weight percentage range of ~~about~~ 0.01wt% to ~~about~~ 1.0wt% based on the total weight of the polyolefin composite.

~~42~~35. The polyolefin composite of any one of the preceding claims, further comprising additives selected from the group consisting of a slipping agent, an antistatic agent, a pigment, and a combination thereof.

~~43~~36. The polyolefin composite of any one of the preceding claims, further comprising a styrene-based polymer.

~~44~~37. The polyolefin composite of claim ~~43~~36, wherein the styrene-based polymer is selected from the group consisting of polystyrene and styrene-acrylonitrile resin, and a combination thereof.

~~45~~38. A method of providing a polyolefin composite, comprising a matrix comprising a polyolefin, a polymer having a moiety grafted thereon, and a polymerisable epoxide linker, wherein the polymerisable epoxide linker is derived from a polymerisable epoxide resin obtained by a reaction between an amine and an epoxide-containing precursor, wherein the amine is selected from the group consisting of tetraglycidyldiaminodiphenylmethane, aminophenol, aminocresol, xylenediamine, and a combination thereof, wherein the moiety grafted on the polymer is covalently bonded to the polymerisable epoxide linker via a chemical bond, and a filler disposed within the matrix,

the method comprising

(i) mixing a polyolefin, a polymer having a moiety grafted thereon, a polymerisable epoxide resin obtained by a reaction between an amine and an epoxide-containing precursor, wherein the amine is selected from the group consisting of tetraglycidyldiaminodiphenylmethane, aminophenol, aminocresol, xylenediamine, and a combination thereof, and a filler;

(ii) melting the mixture of step (i); and

(iii) kneading the mixture of step (ii).

4639. The method of claim 4538, wherein mixing the polyolefin, the polymer having a moiety grafted thereon, the polymerisable epoxide resin and the filler is carried out in a mixer or a drum tumbler.

4740. The method of claim 4538 or 4639, wherein melting the mixture of step (i) comprises formation of the chemical bond between the moiety grafted on the polymer and the polymerisable epoxide linker, optionally at a temperature of ~~about~~ 120 °C to ~~about~~ 250 °C, or optionally at a temperature of ~~about~~ 120 °C to ~~about~~ 190 °C, or optionally at a temperature of ~~about~~ 190 °C to ~~about~~ 250 °C.

4841. The method of any one of claims 4538 to 4740, wherein ~~the polymerisable linker is a polymerisable epoxide linker and~~ melting the mixture of step (i) comprises formation of an ester bond between the moiety grafted on the polymer and the polymerisable epoxide linker.

4942. The method of any one of claims 4538 to 4841, wherein melting and kneading comprises physically agitating the mixture in a mixer, at least one roller, a twin extruder, or a combination thereof.

~~50. A polyolefin composite provided by the method of any one of claims 45 to 49.~~

5143. Use of a polyolefin composite of any one of claims 1 to 4437 in transportation, infrastructure, consumer goods, and/or construction.

~~52~~44. The use of claim ~~51~~43, wherein the transportation is selected from the group consisting of aerospace, automotive, train, and a combination thereof.

~~53~~45. The use of claim ~~51~~43, wherein the infrastructure is selected from the group consisting of pipe, tank, and a combination thereof.

~~54~~46. The use of claim ~~51~~43, wherein the consumer goods are selected from the group consisting of packaging, sporting goods, electronics, and a combination thereof.