Claims

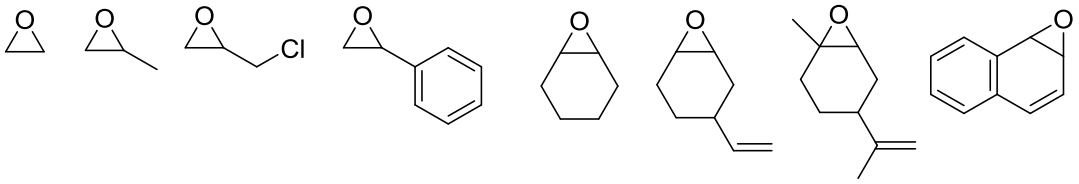
1. A multi-block copolymer comprising at least blocks A-B-A or B-A-B, wherein block A comprises a polyester formed by polymerisation of a lactone and/or a lactide; and block B comprises a copolyester formed by polymerisation of an epoxide and an anhydride, or a polycarbonate formed by polymerisation of an epoxide and carbon dioxide, wherein the multi-block copolymer is characterised by one or more of features (i) to (iii):
(i) a degree of crystallinity (χ) of block A of no more than 20% as determined by DSC; and/or
(ii) a degree of crystallinity (χ) of block A of no more than 20% as determined by WAXS; and/or
(iii) a measureable T_g for each of blocks A and B, with a difference of at least 10ºC between the T_g for blocks A and B.

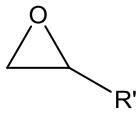
2. The multi-block copolymer of claim 1, wherein block B of the multi-block copolymer is amorphous.

3. The multi-block copolymer of claim 1, wherein:

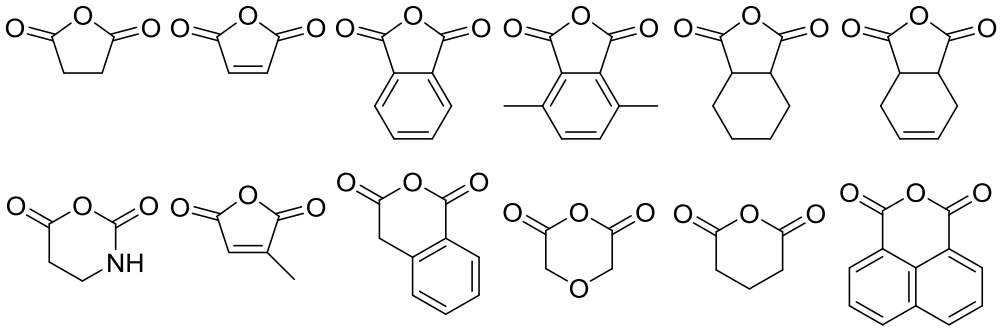
(a) the copolymer has a measureable T_g for each of blocks A and B, with a difference of at least 10ºC or at least 100ºC between the T_g for blocks A and B; and/or

(b) block B has a T_g of ≥30ºC, and no more than 250 ºC; and/or
(c) the multi-block copolymer is characterised by feature (i) or (ii) and feature (iii); and/or
(d) the weight content of block B, with reference to block A, is from 10 to 90%, preferably 20 to 80%, more preferably 30 to 55%; and/or
(e) the multi-block copolymer has a M_n (number average molecular weight) of, at least 1 kg/mol, preferably at least 10kg/mol; and/or
(f) the multi-block copolymer has a Young's modulus of 1MPa to 7000MPa, preferably at least 50 MPa, for example 200MPa to 7000MPa, preferably 223 MPa to 6600 MPa; and/or
(g) the epoxide is



or  wherein R' is optionally substituted C_{2-12}, or a mixture thereof; and/or

(h) the anhydride is

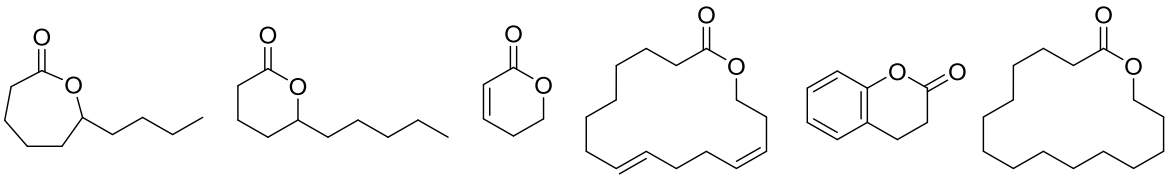


, or a mixture thereof; and/or

(i) the anhydride comprises an aromatic moiety; and/or

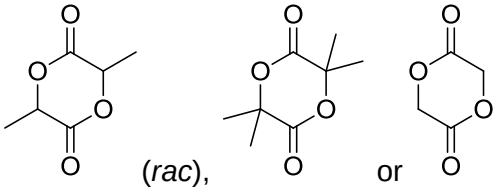
(j) the lactone comprises one or more of an optionally substituted alkyl substituent (e.g. C_{1-10} alkyl, preferably C_{3-8} alkyl) on the hydrocarbon ring, an aromatic component or at least one C=C double bond; and/or

(k) the lactone is selected from:



, or a mixture thereof, or block A comprises a polyester formed by polymerisation of ε-decalactone; and/or

(l) the lactide is

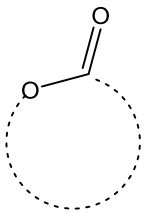


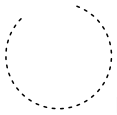
(*rac*), or , or a mixture thereof; and/or

(m) block B comprises: (a) poly(cyclohexylene phthalic)ester, an alternating copolyester formed from polymerization of cyclohexene oxide and phthalic anhydride; (b) a polycarbonate formed from polymerization of cyclohexene oxide and carbon dioxide or

4-vinyl-1-cyclohexene 1,2-epoxide and carbon dioxide; or a combination thereof, preferably wherein block B comprises poly(cyclohexylene phthalic)ester.

4. A multi-block copolymer comprising at least blocks A-B-A or B-A-B, wherein block A comprises a polyester formed by polymerisation of a lactone and/or a lactide; and block B comprises a copolyester formed by polymerisation of an epoxide and an anhydride, or a polycarbonate formed by polymerisation of an epoxide and carbon dioxide, wherein the block B comprises an aromatic moiety and/or wherein the lactone is as defined below and comprises one or more of (i) one or more of R_a and R_b selected from a substituent other than hydrogen; (ii) an optionally substituted alkyl substituent (e.g. C_{1-10} alkyl, preferably C_{3-8} alkyl) on the hydrocarbon ring, (iii) an aromatic component; and (iv) at least one C=C double bond; and/or with the proviso that the lactone is not ε-caprolactone;
wherein the lactone has the following formula:



wherein  represents a hydrocarbon ring having 2 to 20, preferably at least 4, ring carbon atoms in addition to the carbon of the –C(O)O moiety,
wherein the ring is saturated or contains one or more C=C double bonds and
wherein each saturated ring carbon atom is substituted by R_a and R_b and each unsaturated carbon atom is substituted by R_a, wherein R_a and R_b are independently selected from halogen, nitro, alkoxy, aryloxy, heteroaryloxy, alkylamino, imine, nitrile, acetylide, carboxylate or optionally substituted aliphatic, heteroaliphatic, alicyclic, heteroalicyclic, aryl, branched alkyl heteroaryl, alkylaryl or alkylheteroaryl, or wherein two or more of R_a and R_b on adjacent ring carbon atoms can be taken together to form a saturated, partially saturated or unsaturated 3 to 15 membered, optionally substituted ring system, optionally containing one or more heteroatoms, and wherein the multi-block copolymer is characterised by one or more of features (a) to (c):
(a) a degree of crystallinity (χ) of block A of no more than 20% as determined by DSC; and/or
(b) a degree of crystallinity (χ) of block A of no more than 20% as determined by WAXS; and/or

(c) a measureable T_g for each of blocks A and B, with a difference of at least 10ºC between the T_g for blocks A and B.

5. The multi-block copolymer of claim 4, wherein:

(a) block A comprises a polyester formed by polymerisation of ε-decalactone; and/or
(b) block B comprises (i) poly(cyclohexylene phthalic)ester, an alternating copolyester formed from polymerization of cyclohexene oxide and phthalic anhydride; (ii) a polycarbonate formed from polymerization of cyclohexene oxide and carbon dioxide or 4-vinyl-1-cyclohexene 1,2-epoxide and carbon dioxide; or a combination thereof, preferably wherein block B comprises poly(cyclohexylene phthalic)ester.

6. The multi-block copolymer of claim 4, comprising the features of claim 1.

7. The multi-block copolymer of claim 6, comprising the features of claim 2 or 3.