SUMMARY

[0005] In one approach or example, a flexible block copolymer is described herein. These polymers may be useful in an epoxy component of a two-part, epoxy-amine system. In some examples, the flexible block copolymer includes a hydrophobic polyol block; functional endcaps provided by epoxy groups, acetoacetate groups, or both, the endcaps having a functionality greater than 1; and optional isocyanate-functional extension groups. In other examples of the polymer, when the hydrophobic polyol block includes epoxy or fatty acid derived polyol groups, then the flexible copolymer further includes one or more cyclic ester-derived blocks between the hydrophobic polyol block and the functional endcaps, wherein each cyclic ester-derived block includes the residue of at least 3 or more repeating cyclic ester groups.

[0005a] In one aspect, the disclosure refers to a flexible block copolymer for use in an epoxy component of a two-part, epoxy-amine system, the flexible block copolymer comprising:

a hydrophobic polyol block;

functional endcaps provided by acetoacetate groups, the endcaps having a functionality greater than 1;

optional isocyanate-functional extension groups;

one or more cyclic ester-derived blocks between the hydrophobic polyol block and the functional endcaps, wherein each cyclic ester-derived block includes the residue of at least 3 or more repeating cyclic ester groups and wherein each cyclic ester-derived block has a number average molecular weight of 300 to 1500 g/mol; and

wherein the hydrophobic polyol block includes a C20 to a C60 dimer and trimer fatty acid diol having 1 to 10 weight percent of the trimer fatty acid.

[0006] The flexible block copolymer as described in the previous paragraph may have additional examples when combined with one or more optional features in any combination. These optional features may include one or more of the following: wherein the hydrophobic polyol block includes a C20 to a C60 dimer or trimer fatty acid diol and wherein the one or more cyclic ester-derived blocks includes the residue of at least 3 or more repeating lactone groups; and/or where the hydrophobic polyol block includes a polyalkyleneglycol diol having a number average molecular weight of about 500 to about 2000 g/mol; and/or wherein the polyalkylene glycol diol is a polyethylene glycol diol or a polypropylene glycol diol; and/or

wherein the hydrophobic polyol block is derived from a diester of a digycidyl ether; and/or wherein the hydrophobic polyol block is derived from glycidyl ethers of (cyclo)aliphatic or aromatic hydroxy compounds or derived from glycidyl ethers based on polyhydric alcohols or phenols; and/or wherein the hydrophobic polyol block is derived from a diester of a digycidyl ester; and/or wherein the hydrophobic polyol block is derived from polyglycidyl esters of polycarboxylic acids; and/or further comprising the isocyanate-functional extension groups selected from 2,2,4-trimethylhexamethylene diisocyanate, isophorone diisocyanate, 1,6-hexane diisocyanate, methylene bis (4-cyclohexylisocyanate), and combinations thereof; and/or wherein the functional endcaps includes acetoacetate groups; and/or wherein the acetoacetate groups are derived from C1 to C6 acetoacetate.

[0007] In another approach or example, this disclosure also describes a flexible block copolymer, suited in some approaches for use in an epoxy component of a two-part, epoxy-amine system, including the reaction product of (i) a hydrophobic polyol selected from a C20 to

C60 dimer or trimer fatty acid, diesters of a digycidyl ether, diesters of a digycidyl ester, and combinations thereof; (ii) optional isocyanate-functional extension groups, and (iii) one or more C4 to C9 cyclic esters; the reaction product is functionally end capped with epoxy groups, acetoacetate groups, or both. In some approaches, the endcaps have a functionality greater than 1. In other approaches, the one or more C4 to C9 cyclic esters form a cyclic ester-derived block of the flexible block copolymer including at least 3 or more repeating cyclic ester-derived groups.

[0007a] In another aspect, the disclosure refers to a flexible block copolymer for use in an epoxy component of a two-part, epoxy-amine system, the flexible block copolymer comprising the reaction product of (i) a hydrophobic polyol including a C20 to C60 dimer and trimer fatty acid diol having 1 to 10 weight percent of the trimer fatty acid; (ii) optional isocyanate-functional extension groups, and (iii) one or more C4 to C9 cyclic esters; the reaction product is functionally end capped with acetoacetate groups, the endcaps having a functionality greater than 1; and wherein the one or more C4 to C9 cyclic esters form a cyclic ester-derived block of the flexible block copolymer including at least 3 or more repeating cyclic ester-derived groups and wherein each cyclic ester-derived block has a number average molecular weight of 300 to 1500 g/mol.

[0008] The flexible block copolymer as described in the previous paragraph may have additional examples when combined with one or more optional features in any combination. These optional features may include one or more of the following: wherein the hydrophobic polyol is the C20 to a C60 dimer or trimer fatty acid and wherein the cyclic ester-derived block includes the residue of at least 3 or more repeating caprolactone-derived groups; and/or wherein the hydrophobic polyol is derived from a diester of a digycidyl ether; and/or wherein the hydrophobic polyol block is derived from glycidyl ethers of (cyclo)aliphatic or aromatic hydroxy compounds including one or more of ethylene glycol, glycerol or cyclohexanediol; and/or wherein the hydrophobic polyol is derived from a diester of a digycidyl ester; and/or wherein the hydrophobic polyol block is derived from polyglycidyl esters of polycarboxylic acids; and/or further comprising isocyanate-functional extension groups selected from 2,2,4-trimethylhexamethylene diisocyanate, isophorone diisocyanate, 1,6-hexane diisocyanate, methylene bis (4-cyclohexylisocyanate), and combinations thereof; and/or,

wherein the functional endcaps includes the acetoacetate groups derived from C1 to C6 acetoacetate.

[0008a] In another aspect, the disclosure refers to a coating composition including the flexible block copolymer as defined above.

[0009] In yet another approach or example, a coating compositions is described herein, such as an epoxy/amine two-part coating composition, including any of the above described examples of flexible block copolymers from the preceding paragraphs.

[00010] In yet further approaches or examples, a use of the flexible block copolymers herein is described to provide a flexible polymer at temperatures down to about -60ºC and the use of such copolymers within the coating compositions as described herein to achieve such flexibility.

CLAIMS

What is claimed is:

1. A flexible block copolymer for use in an epoxy component of a two-part, epoxy-amine system, the flexible block copolymer comprising:

a hydrophobic polyol block;

functional endcaps provided by acetoacetate groups, the endcaps having a functionality greater than 1;

optional isocyanate-functional extension groups;

one or more cyclic ester-derived blocks between the hydrophobic polyol block and the functional endcaps, wherein each cyclic ester-derived block includes the residue of at least 3 or more repeating cyclic ester groups and wherein each cyclic ester-derived block has a number average molecular weight of 300 to 1500 g/mol; and

wherein the hydrophobic polyol block includes a C20 to a C60 dimer and trimer fatty acid diol having 1 to 10 weight percent of the trimer fatty acid.

2. The flexible polymer according to claim 1, wherein the one or more cyclic ester-derived blocks includes the residue of at least 3 or more repeating lactone groups.

3. The flexible polymer according to claim 1, further comprising the isocyanate-functional extension groups selected from 2,2,4-trimethylhexamethylene diisocyanate, isophorone diisocyanate, 1,6-hexane diisocyanate, methylene bis (4-cyclohexylisocyanate), and combinations thereof.

4. The flexible polymer according to claim 1, wherein the acetoacetate groups are derived from C1 to C6 acetoacetate.

5. The flexible block copolymer according to claim 1, wherein the flexible block copolymer includes 35 to 52 weight percent of the one or more cyclic ester derived blocks and 30 to 45 weight percent of the hydrophobic polyol block.

6. A flexible block copolymer for use in an epoxy component of a two-part, epoxy-amine system, the flexible block copolymer comprising the reaction product of (i) a hydrophobic polyol including a C20 to C60 dimer and trimer fatty acid diol having 1 to 10 weight percent of the trimer fatty acid; (ii) optional isocyanate-functional extension groups, and (iii) one or more C4 to C9 cyclic esters; the reaction product is functionally end capped with acetoacetate groups, the endcaps having a functionality greater than 1; and wherein the one or more C4 to C9 cyclic esters form a cyclic ester-derived block of the flexible block copolymer including at least 3 or more repeating cyclic ester-derived groups and wherein each cyclic ester-derived block has a number average molecular weight of 300 to 1500 g/mol.

7. The flexible block copolymer according to claim 6, wherein the cyclic ester-derived block includes the residue of at least 3 or more repeating caprolactone-derived groups.

8. The flexible block copolymer according to claim 6, further comprising the isocyanate-functional extension groups selected from 2,2,4-trimethylhexamethylene diisocyanate, isophorone diisocyanate, 1,6-hexane diisocyanate, methylene bis (4-cyclohexylisocyanate), and combinations thereof.

9. The flexible block copolymer according to claim 6, wherein the functional endcaps includes the acetoacetate groups derived from C1 to C6 acetoacetate.

10. A coating composition including the flexible block copolymer of claim 6.