We claim:

1. A method of forming a microelectronic structure, said method comprising:

providing a substrate having a back surface and a front surface, said substrate optionally including one or more intermediate layers on said front surface;

applying a composition to said front surface, or to said one or more intermediate layers, if present, to form a bonding layer, said composition comprising a bismaleimide dispersed or dissolved in a solvent system; and

performing at least one of (A), (B), or (C):

(A) attaching a die or a wafer comprising at least one die to said bonding layer;

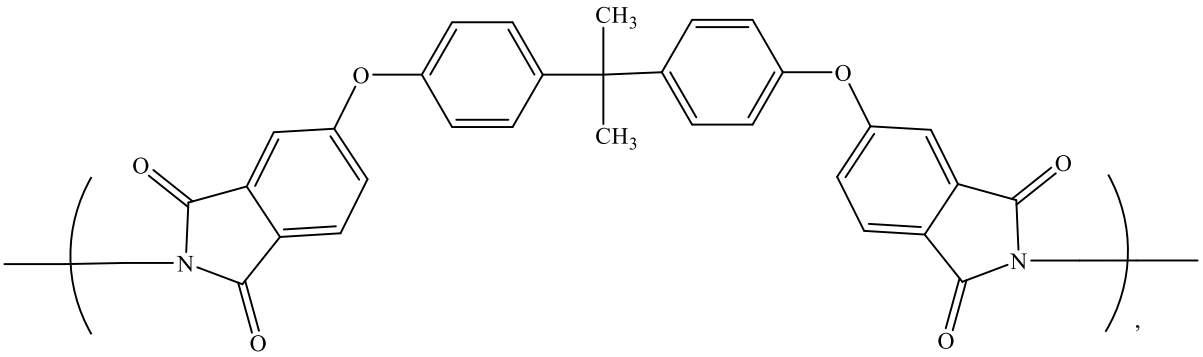
(B) forming a photoresist layer on said bonding layer;

forming a pattern in said photoresist layer; and

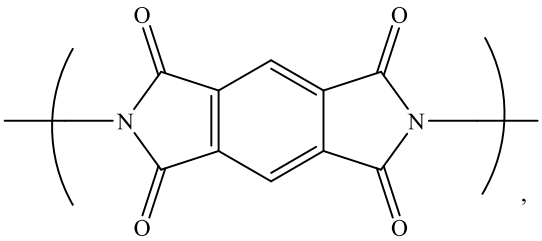
transferring said pattern to said bonding layer to form a patterned bonding layer; or

(C) exposing the bonding layer to laser energy so as to remove at least a portion of the bonding layer.

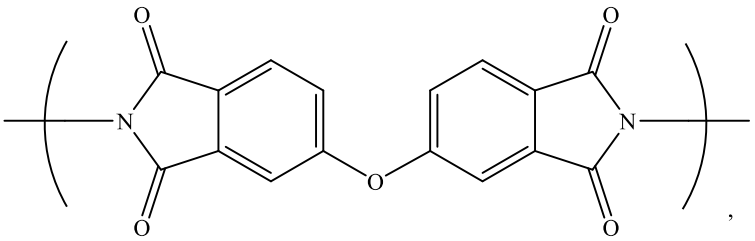
2. The method of claim 1, wherein said bismaleimide comprises a moiety chosen from



(I)



(II)



(III)

(I) and (II), (II) and (III), (I) and (III), or (I), (II), and (III).

3. The method of claim 2, wherein said bismaleimide comprises 1 to about 15 of said moieties.

4. The method of claim 1, wherein said composition further comprises a compound chosen from comonomers, crosslinking agents, initiators, surfactants, wetting agents, adhesion promoters, dyes, pigments, copolymers, and mixtures thereof.

5. The method of claim 4, wherein said composition comprises a comonomer chosen from tri(ethylene glycol) divinyl ether, 1,4-butanediol divinyl ether, 1,4-cyclohexanedimethanol divinyl ether, di(ethylene glycol) divinyl ether, poly(ethylene glycol) divinyl ether, divinyl adipate, vinyl ether crosslinkers, 1H-Pyrrole-2,5-dione, 1,1’-C36-alkylenebis-, and mixtures thereof.

6. The method of claim 1, wherein said composition consists essentially of:

said bismaleimide;

at least one of an initiator, a comonomer, and/or adhesion promoter; and

said solvent system.

7. The method of claim 1, wherein said performing comprises performing (B), and further comprising placing:

a die on or in said patterned bonding layer; or

a wafer comprising at least one die on said patterned bonding layer.

8. A microelectronic structure comprising:

a microelectronic substrate having a surface;

optionally one or more intermediate layers on said substrate surface, there being an uppermost intermediate layer on said substrate surface, if one or more intermediate layers are present;

a bonding layer on said uppermost intermediate layer, if present, or on said substrate surface, if no intermediate layers are present, wherein said bonding layer comprises at least one of a bismaleimide or a crosslinked bismaleimide; and

at least one of

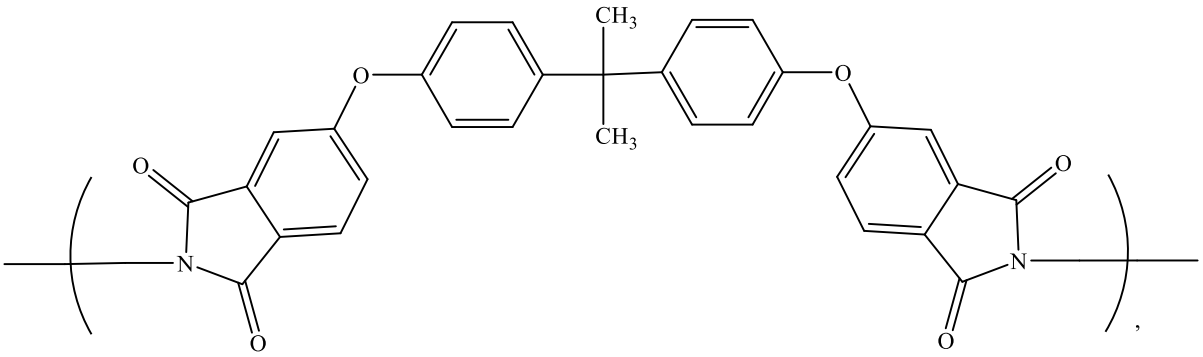
(A) a die on or in said bonding layer

(B) a wafer comprising at least one die on said bonding layer;

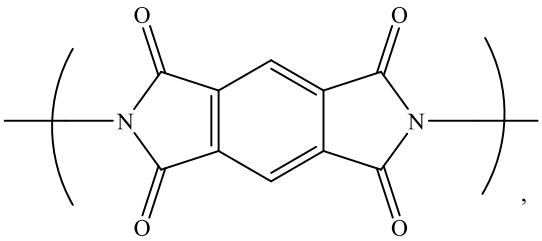
(C) a patterned photoresist layer on said bonding layer; or

(D) a carrier wafer on said bonding layer.

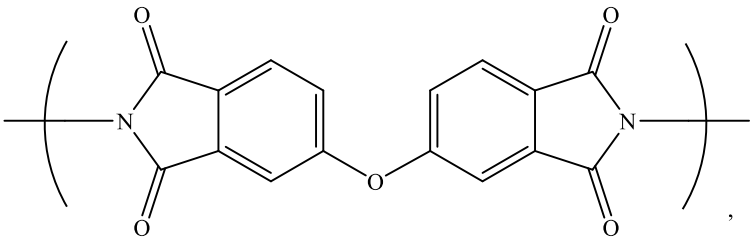
9. The structure of claim 8, wherein said bismaleimide comprises a moiety chosen from



(I)



(II)



(III)

(I) and (II), (II) and (III), (I) and (III), or (I), (II), and (III).

10. The structure of claim 9, wherein said bismaleimide comprises 1 to about 15 of said moieties.

11. The structure of claim 8, wherein said bonding layer further comprises at least one of a comonomer, crosslinking agent, or copolymer.

12. The structure of claim 11, wherein said bonding layer comprises a comonomer chosen from tri(ethylene glycol) divinyl ether, 1,4-butanediol divinyl ether, 1,4-cyclohexanedimethanol divinyl ether, di(ethylene glycol) divinyl ether, poly(ethylene glycol) divinyl ether, divinyl adipate, vinyl ether crosslinkers, 1H-Pyrrole-2,5-dione, 1,1'-C36-alkylenebis-, and mixtures thereof.

13. The structure of claim 11, wherein said comonomer is reacted with said bismaleimide.

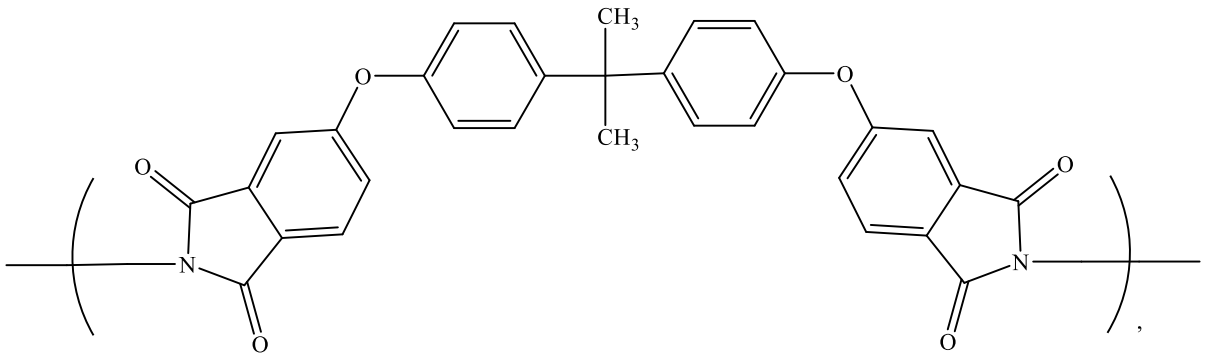
14. The structure of claim 8, wherein said bonding layer consists essentially of:
one or both of said bismaleimide or said crosslinked bismaleimide; and
at least one of a comonomer and/or copolymer.

15. The structure of claim 8, wherein said microelectronic substrate is selected from the group consisting of silicon substrates, aluminum substrates, tungsten substrates, tungsten silicide substrates, gallium arsenide substrates, germanium substrates, tantalum substrates, tantalum nitrite substrates, silicon germanium substrates, glass substrates, copper substrates, chrome substrates, zinc substrates, silicon oxide substrates, silicon nitride substrates, and combinations thereof.

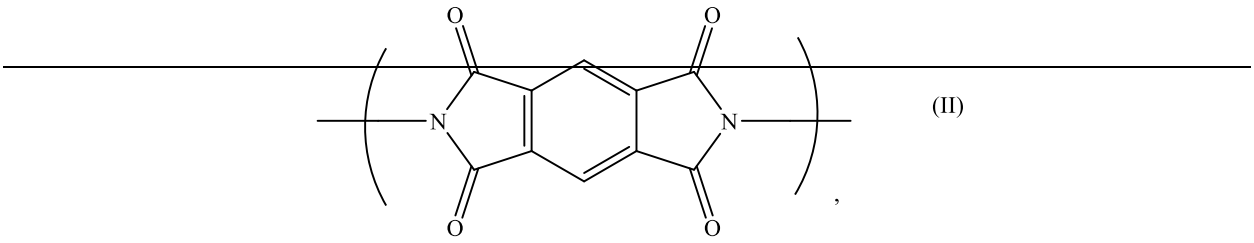
16. The structure of claim 8, wherein said structure comprises (D), and said carrier wafer comprises a glass substrate.

~~17. A temporary bonding method comprising:~~
~~providing a stack comprising:~~
~~a first substrate having a back surface and a front surface, said substrate optionally including one or more intermediate layers on said front surface;~~
~~a bonding layer on said front surface, or on said one or more intermediate layers, if present, said bonding layer comprising one or both of a bismaleimide or a crosslinked bismaleimide; and~~
~~a second substrate having a first surface, said bonding layer being on said first surface; and~~
~~exposing said bonding layer to laser or other energy so as to facilitate separation of said first and second substrates.~~

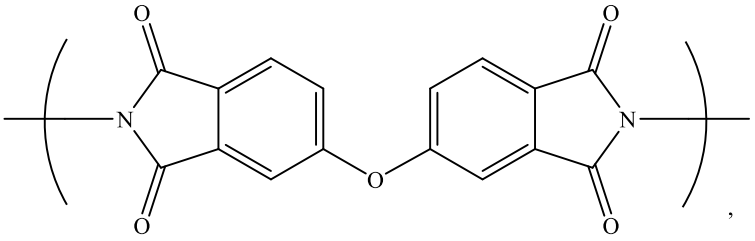
~~18. The method of claim 17, wherein said bismaleimide comprises a moiety chosen from~~



(I)



(II)



(III)

~~(I) and (II), (II) and (III), (I) and (III), or (I), (II), and (III).~~

~~19. The method of claim 18, wherein said bismaleimide comprises 1 to about 15 of said moieties.~~

~~20. The method of claim 17, wherein said bonding layer further comprises at least one of a comonomer, crosslinking agent, or copolymer.~~

~~21. The method of claim 20, wherein said bonding layer comprises a comonomer chosen from tri(ethylene glycol) divinyl ether, 1,4-butanediol divinyl ether, 1,4-cyclohexanedimethanol divinyl ether, di(ethylene glycol) divinyl ether, poly(ethylene glycol) divinyl ether, divinyl adipate, vinyl ether crosslinkers, 1H-Pyrrole-2,5-dione, 1,1'-C36-~~

alkylenebis-, and mixtures thereof.

22. The method of claim 20, wherein said comonomer is reacted with said bismaleimide.

23. The method of claim 17, wherein said composition consists essentially of:
one or both of said bismaleimide or said crosslinked bismaleimide; and
at least one of a comonomer and/or copolymer.

24. The method of claim 17, wherein at least one of said first and second substrates is selected from the group consisting of silicon substrates, aluminum substrates, tungsten substrates, tungsten silicide substrates, gallium arsenide substrates, germanium substrates, tantalum substrates, tantalum nitrite substrates, silicon germanium substrates, glass substrates, copper substrates, chrome substrates, zinc substrates, silicon oxide substrates, silicon nitride substrates, and combinations thereof.

25. The method of claim 17, wherein one of said first and second substrates is a device wafer, and the other of said first and second substrates is a carrier wafer.

26. A bonding method comprising:

a) providing a first substrate having an upper surface, there being a first set of features chosen from pads, pillars, microbumps, or combinations thereof formed in or on said upper surface;

b) applying a photosensitive composition to said upper surface so as to cover at least some of said first set of features and form a bonding layer, said composition comprising a compound dispersed or dissolved in a solvent system;

c) removing some of said bonding layer so as to uncover at least some of said first set of features, yielding a patterned bonding layer;

d) exposing said patterned bonding layer to energy; and

e) bonding a second substrate to said first substrate, said second substrate comprising a second set of features having a pattern configured to be received within the patterned bonding layer so that at least some of said first set of features contacts at least some of said second set of features, where exposing (d) can be carried out before bonding (e), or bonding (e) can be

carried out before exposing (d).

27. The method of claim 26, wherein said removing (c) comprises:

selectively exposing portions of said bonding layer to radiation to render the exposed portions insoluble in a developer; and

removing said exposed portions with developer so as to uncover the at least some of said features.

28. The method of claim 26, wherein said exposing (d) comprises exposing said patterned bonding layer to one or both of heat or UV light.

29. The method of claim 26, wherein said first set of features has a pitch of less than about 40 μm.

30. The method of claim 26, wherein said applying (b) results in said bonding layer covering all of said first set of features.

31. The method of claim 26, wherein:

said first substrate and said second substrate comprise chips;

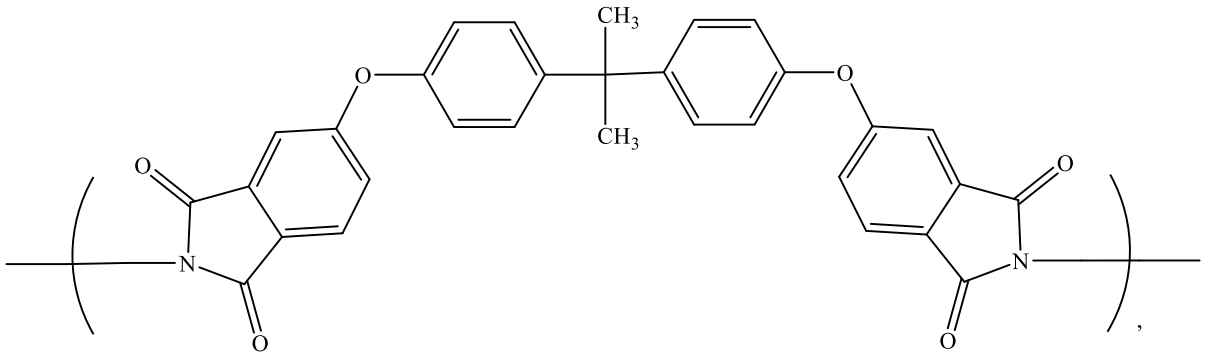
said first substrate and said second substrate comprise wafers; or

wherein said first substrate comprises a wafer and said second substrate comprises a chip.

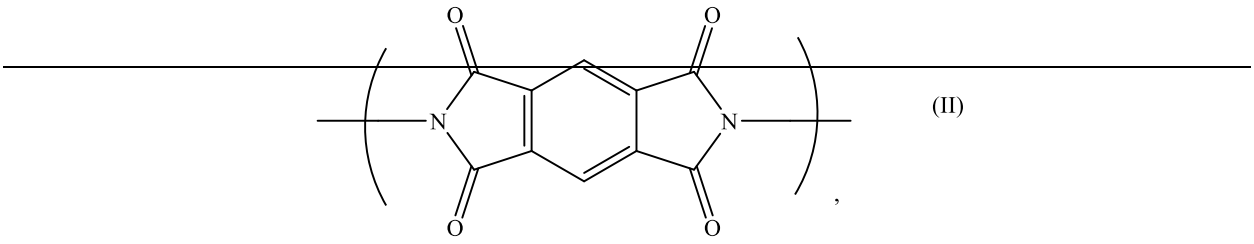
32. The method of claim 26, wherein no additional layers are applied to said bonding layer before said removing (c).

33. The method of claim 26, said compound comprising a bismaleimide.

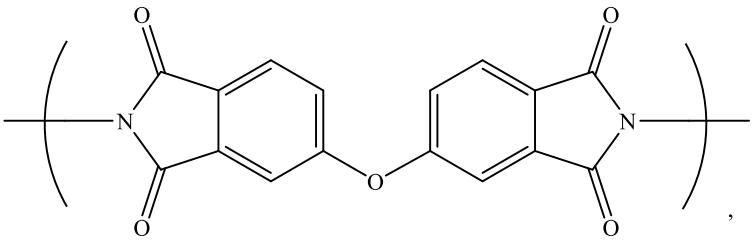
34. The method of claim 33, wherein said bismaleimide comprises a moiety chosen from



(I)



(II)



(III)

~~(I) and (II), (II) and (III), (I) and (III), or (I), (II), and (III).~~

~~35. The method of claim 34, wherein said bismaleimide comprises 1 to about 15 of said moieties.~~

~~36. The method of claim 26, wherein said composition further comprises a compound chosen from comonomers, crosslinking agents, initiators, surfactants, wetting agents, adhesion promoters, dyes, pigments, copolymers, and mixtures thereof.~~

~~37. The method of claim 36, wherein said composition comprises a comonomer chosen from tri(ethylene glycol) divinyl ether, 1,4-butanediol divinyl ether, 1,4-cyclohexanedimethanol divinyl ether, di(ethylene glycol) divinyl ether, poly(ethylene glycol) divinyl ether, divinyl adipate, vinyl ether crosslinkers, 1H-Pyrrole-2,5-dione, 1,1'-C36-alkylenebis-, and mixtures thereof.~~

38. The method of claim 33, wherein said composition consists essentially of:

said bismaleimide;

at least one of an initiator, a comonomer, and/or adhesion promoter; and

said solvent system.

39. A microelectronic structure comprising:

a first substrate having an upper surface, there being:

a first set of features chosen from pillars, microbumps, or both pillars and microbumps formed in or on said upper surface; and

gaps between said first set of features;

a bonding layer in said gaps, said bonding layer comprising at least one of a bismaleimide or a crosslinked bismaleimide; and

a second substrate bonded to said first substrate, said second substrate having an upper surface comprising a second set of features chosen from pillars, microbumps, or both pillars and microbumps formed in or on said upper surface of said second substate, at least some of said second set of features being in contact with at least some of said first set of features.

40. The structure of claim 39, wherein said first set of features has a pitch of less than about 40 μm.

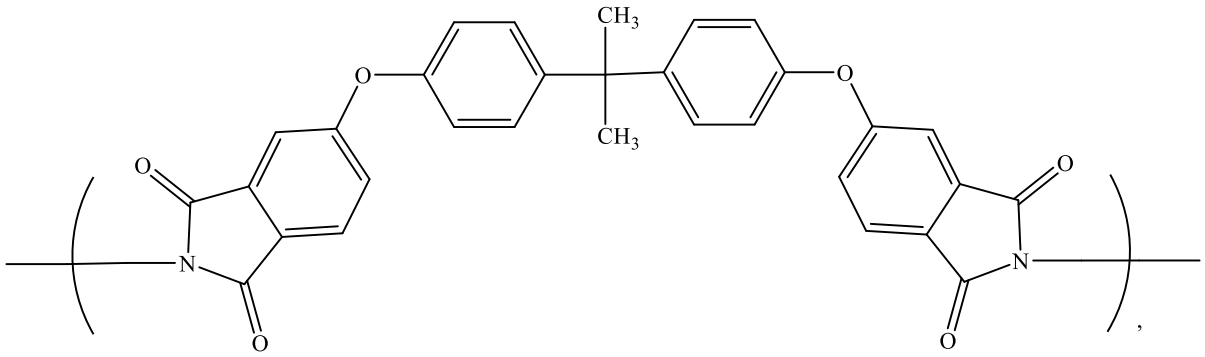
41. The structure of claim 39, wherein:

said first substrate and said second substrate comprise chips;

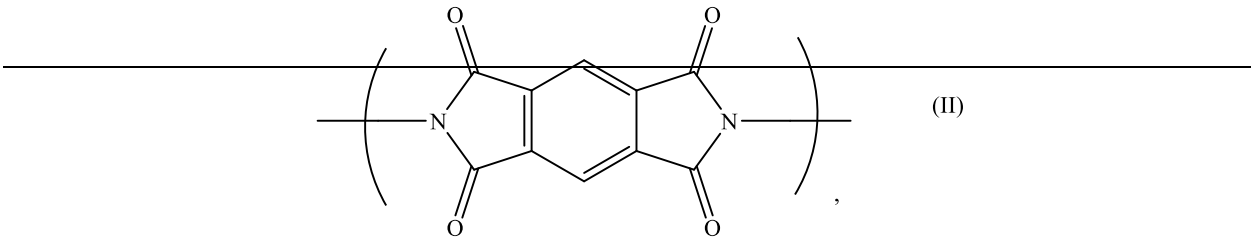
said first substrate and said second substrate comprise wafers; or

wherein said first substrate comprises a wafer and said second substrate comprises a chip.

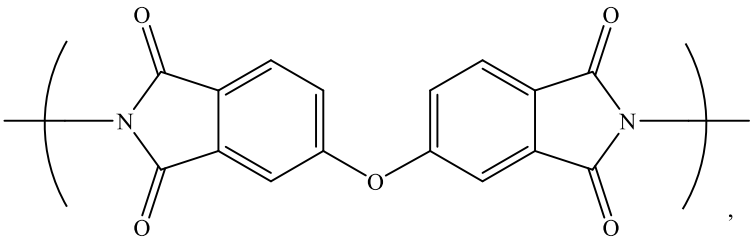
42. The structure of claim 38, wherein said bismaleimide comprises a moiety chosen from



(I)



(II)



(III)

~~(I) and (II), (II) and (III), (I) and (III), or (I), (II), and (III).~~

~~43. The structure of claim 42, wherein said bismaleimide comprises 1 to about 15 of said moieties.~~

~~44. The structure of claim 39, wherein said bonding layer further comprises at least one of a comonomer, crosslinking agent, or copolymer.~~

~~45. The structure of claim 44, wherein said bonding layer comprises a comonomer chosen from tri(ethylene glycol) divinyl ether, 1,4-butanediol divinyl ether, 1,4-cyclohexanedimethanol divinyl ether, di(ethylene glycol) divinyl ether, poly(ethylene glycol) divinyl ether, divinyl adipate, vinyl ether crosslinkers, 1H-Pyrrole-2,5-dione, 1,1'-C36-alkylenebis-, and mixtures thereof.~~

~~46. The structure of claim 44, wherein said comonomer is reacted with said bismaleimide.~~

~~47. The structure of claim 39, wherein said bonding layer consists essentially of:~~
~~one or both of said bismaleimide or said crosslinked bismaleimide; and~~
~~at least one of a comonomer and/or copolymer.~~