aromatic alkene, alkyne, CH_3-$(CH_2)_n$- (where n = 0 to 12), or an aromatic moiety;

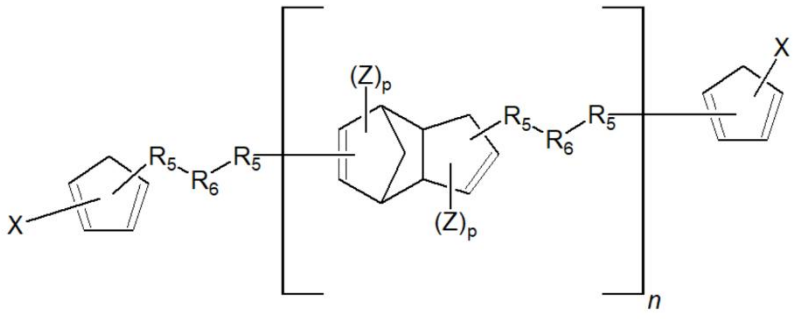
(d) each Z is independently either H or X, and each p is independently an integer from 1-4;

(e) each w is independently 0, or an integer greater than or equal to 1, and

(i) when w is 0, the bracket region represents a bond and n is an integer greater than or equal to 1;

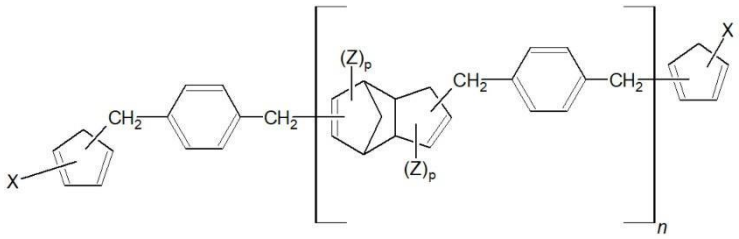
and wherein the polymer, copolymer or oligomer comprises a dissipation (Df) value ranging from between 0.0001 to 0.004.

In some examples of Formula (I), the value of w is equal to zero, representing a bond between the R_5 group and the cyclopentadiene or dicyclopentadiene. These compounds of Formula (I) may be defined by Formula (II):



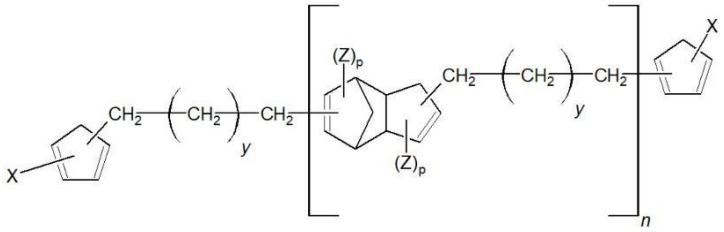
(II)

In another aspect, there is provided a polymer, copolymer or oligomer derived from one or more resins having a structure defined by Formula (II)



and isomers thereof, and;

(b) a second resin comprises a structure:



and isomers thereof;

wherein

(i) each X is independently an allyl, benzyl, or styrenyl group, and;
(ii) each Z is independently either H or X, and each p is independently an integer from 1-4;

(iii) n is an integer greater than or equal to 1, and;

(iv) y = 1 – 12, and;

(iv) the polymer, copolymer, or oligomer comprises a dissipation value (Df) value ranging from 0.0001 to 0.004.

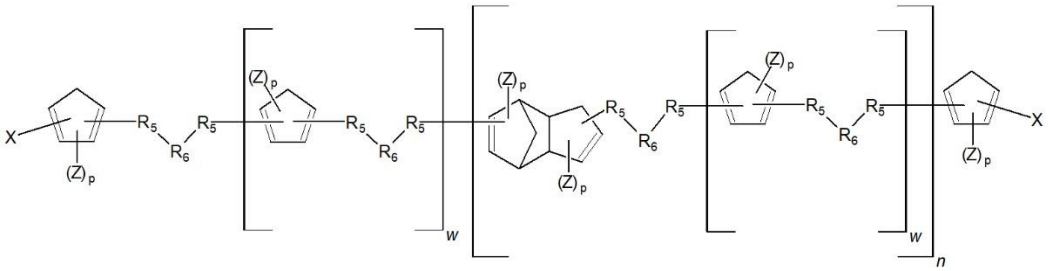
DETAILED DESCRIPTION OF THE INVENTION

The invention provides a thermosetting resin with a high glass transition temperature, which has excellent dielectric properties and low water absorption. Embodiments of this

CLAIMS

What is claimed is:

1. A polymer, copolymer or oligomer derived from a resin having a structure defined by Formula (I)



(I)

wherein:

(a) each R_5 is independently a methylene group (CH_2), or a methylene group substituted with one or more -H, -CH_3, or halogen functionalities;

(b) each R_6 is independently a bond or a straight-chain or branched, linear or cyclic, saturated or unsaturated, substituted or unsubstituted, aliphatic or aromatic group having between 1 and 20 carbon atoms;

(c) each X is independently a functionality possessing at least one non-aromatic alkene, alkyne, CH_3-$(CH_2)_n$- (where n = 0 to 12), or an aromatic moiety;

(d) each Z is independently either H or X, and each p is independently an integer from 1-4;

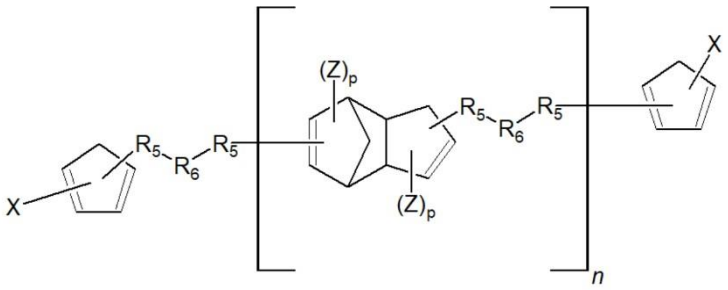
(e) each w is independently 0, or an integer greater than or equal to 1, and

(i) when w is 0, the bracket region represents a bond and n is an

integer greater than or equal to 1;

and wherein the polymer, copolymer or oligomer comprises a dissipation (Df) value ranging from between 0.0001 to 0.004.

2. The polymer, copolymer or oligomer of Claim 1 wherein w = 0, said resin being defined by Formula (II)



(II)

3. The polymer, copolymer or oligomer of Claim 1, wherein R_5 is methylene (-CH_2-) and R_6 is a bond or an aliphatic carbon chain of the form –(CH_2)y-, wherein y = 1 – 12.

4. The polymer, copolymer or oligomer of Claim 1, wherein R_5 is methylene (-CH_2-), and R_6 is

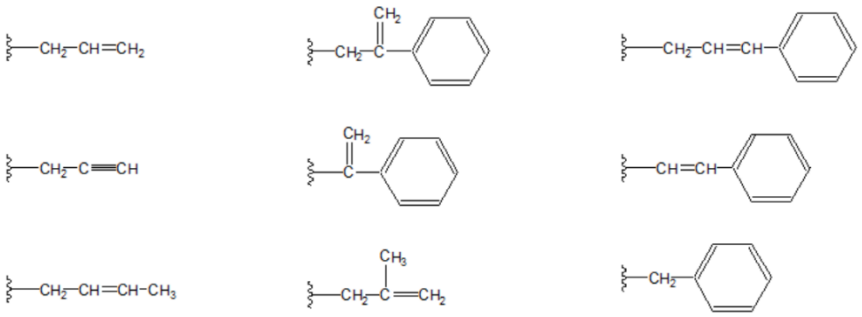
a member selected from the group consisting of phenyl, napthyl, anthryl, or biphenyl.

5. The polymer, copolymer or oligomer of Claim 1, wherein R_5 is methylene (-CH_2-), and each R_6 is selected from at least two independently defined groups.

6. The polymer, copolymer or oligomer of Claim 1, wherein X is a member selected from the group consisting of propenylbenzene, ethenylbenzene, (methyl)ethenylbenzene,

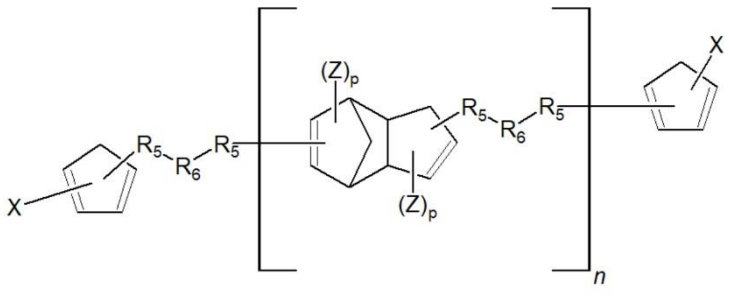
styrenyl, allyl, propargyl, butenyl, or benzyl group.

7. The polymer, copolymer or oligomer of Claim 1, wherein X is a member selected from the group consisting of



and isomers thereof.

8. A polymer, copolymer or oligomer derived from one or more resins having a structure defined by Formula (II)



(II)

wherein:

(a) each R_5 is a methylene group (CH_2);

(b) each R_6 is independently a bond, a phenyl group, or an aliphatic carbon chain of the form $–(CH_2)_y-$, wherein y = 1 – 12.

(c) each X is independently an allyl, propargyl, butenyl, benzyl, or styrenyl group;

(d) each Z is independently either H or X, and each p is independently an integer from 1- 4;

(e) n is an integer greater than or equal to 1.

9. The polymer, copolymer or oligomer of Claim 8, wherein the polymer, copolymer or oligomer is soluble in an organic solvent selected from the group consisting of Methyl ethyl ketone (MEK), Xylenes, N-Methyl pyrrolidone (NMP), Dimethylformamide (DMF), Dichloromethane (DCM), Acetonitrile, Acetone, Dimethyl sulfoxide (DMSO), and Tetrahydrofuran (THF).

10. The polymer, copolymer or oligomer of Claim 8, wherein the polymer, copolymer or oligomer comprises a molecular weight ranging from 200 to 1,000,000 Da.

11. The polymer, copolymer or oligomer of Claim 8, further comprising an additive selected from the group consisting of adhesion agents, peroxides, crosslinking agents, antioxidants, flame retardants, diluents and fillers.

12. The polymer, copolymer or oligomer of Claim 8, wherein the polymer, copolymer or oligomer comprises a dielectric (Dk) value ranging from between 1.5 to 3 at 1 – 50 GHz.

13. The polymer, copolymer or oligomer of Claim 8, wherein the polymer, copolymer or oligomer comprises a dissipation (Df) value ranging from between 0.0001 to 0.004 at 1 – 50 GHz.

14. A composition comprising (i) a polymer, copolymer or oligomer of Claim 8; and (ii) a second component selected from the group consisting of polyethylenes, polypropylenes, polybutylenes, low vinyl polybutadienes, high vinyl polybutadienes, polystyrenes, butadiene-styrene copolymers, styrene-maleic anhydride (SMA) polymers, acrylonitrile-butadiene-styrene (ABS) polymers, polydicyclopentadienes, epoxies, polyurethanes, cyanate esters, poly(phenylene oxide), ethylene-propylene-diene monomer (EPDM) polymers, cyclic olefin copolymers (COC), polyimides, bismaleimides, phosphazenes, olefin-modified phosphazenes, acrylates, vinyl esters, polylactones, polycarbonates, polysulfones, polythioethers, polyetheretherketones (PEEK), polydimethylsiloxanes (PDMS), polyethylene terephthalates (PET), and polybutylene terephthalates (PBT), styrene, divinylbenzene, 1,2-bis(vinylphenyl)ethane, vinylbenzyl ether compounds, vinyl ether compounds, allyl ether compounds, vinylphenyl monomers, vinyl monomers, and allyl monomers.

15. A copolymer derived from polymerization of the polymer, copolymer, or oligomer of Claim 8, and a comonomer, wherein the comonomer is selected from the group consisting of styrene, divinyl benzene, vinyl toluene, methyl styrene, tert-butyl styrene, alpha-methyl styrene, alpha-methyl styrene dimer, vinyl cyclohexene, ethylidene norbornene, vinyl norbornene, alpha- pinene, beta-pinene, limonene, other terpenes, polybutadienes,

modified polybutadienes, polystyrenes (homopolymer and block-copolymers), modified polystyrenes, polyterpenes, other vinyl-reactive monomers, and reactive dimers/oligomers/polymers/copolymers thereof.

16. A polymer, copolymer or oligomer of Claim 8 comprising a solid material with Tg greater than 150°C wherein the polymer is cured thermally without catalyst or cured with peroxides or other free radical catalysts with or without use of additional co-catalysts.

17. A polymer, copolymer or oligomer of Claim 8 comprising a solid material with Tg greater than 150°C wherein the polymer is cured with cationic catalysts, thermal acid generators (TAGS), and/or photo-acid generators (PAGs) with or without use of additional co-catalysts.

18. A printed circuit board, prepreg, or laminate comprising a material comprised of the polymer, copolymer or oligomer of Claim 8.

19. A radome or satellite structure comprising a material comprised of the polymer, copolymer or oligomer of Claim 8.

20. A base station, circuit board, server, or router comprising a material comprised of the polymer, copolymer or oligomer of Claim 8.

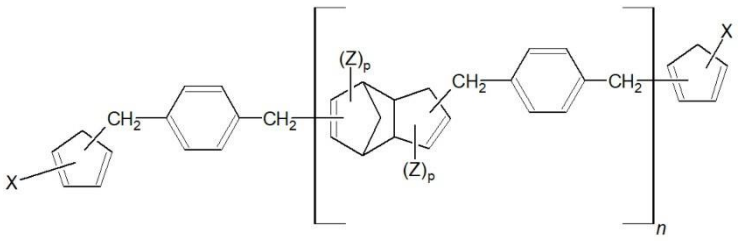
21. A material for use in any one of: (i) a copper-clad laminate (CCL), (ii) a high-density interconnect (HDI) substrate, (iii) an integrated circuit (IC) substrate in printed circuit boards at high temperature and low Df applications; (iv) a molding compound in power

device application; and (v) a radio frequency (RF) heating in oil and gas applications, wherein the material comprises the polymer, copolymer, or oligomer of Claim 8.

22. A 3D printing resin composition comprised of the polymer, copolymer or oligomer of Claim 8 suitable for digital light printing (DLP), continuous liquid interface printing (CLIP), Stereo-lithography (SL).

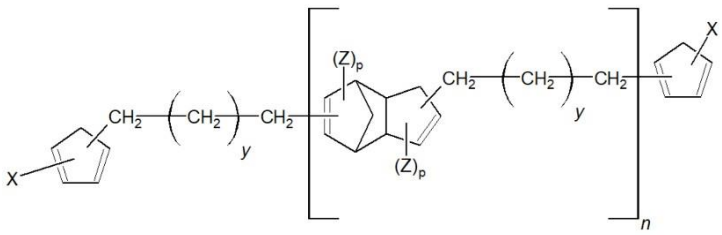
23. A polymer, copolymer, or oligomer derived from at least two resins wherein

(a) a first resin comprises a structure:



and isomers thereof, and;

(b) a second resin comprises a structure:



and isomers thereof;

wherein

(i) each X is independently an allyl, benzyl, or styrenyl group, and;

(ii) each Z is independently either H or X, and each p is independently an integer from 1-4;

(iii) n is an integer greater than or equal to 1, and;

(iv) y = 1 – 12, and;

(iv) the polymer, copolymer, or oligomer comprises a dissipation value (Df) value ranging from 0.0001 to 0.004.

24. A polymer, copolymer or oligomer of Claim 23 comprising a solid material with Tg greater than 150°C wherein:

(a) the polymer is cured thermally without a catalyst;

(b) the polymer is catalyzed thermally with thermal acid generators (TAGS), and/or peroxides;

(c) the polymer is catalyzed via UV light using photo-acid generators (PAGs).