CLAIMS

1. A silsesquioxane resin wherein the silsesquioxane resin is comprised of the units

$(Ph(CH_2)_rSiO_{(3-x)/2}(OR')_x)_m$
$(HSiO_{(3-x)/2}(OR')_x)_n$
$(MeSiO_{(3-x)/2}(OR')_x)_o$
$(RSiO_{(3-x)/2}(OR')_x)_p$
$(R^1SiO_{(3-x)/2}(OR')_x)_q$

where Ph is a phenyl group, Me is a methyl group; R' is hydrogen atom or a hydrocarbon group having from 1 to 4 carbon atoms; R is selected from a carboxylic acid group, a carboxylic acid forming group or mixtures thereof; and R^1 is selected from substituted phenyl groups, ester groups, polyether groups; mercapto groups, sulfur-containing organic functional groups, hydroxyl producing group, aryl sulphonic ester groups, and reactive or curable organic functional groups; and r has a value of 0, 1, 2, 3, or 4; x has a value of 0, 1 or 2; wherein in the resin m has a value of 0 to 0.90; n has a value of 0.05 to 0.99; o has a value of 0 to 0.95; p has a value of 0.01 to 0.5; q has a value of 0 to 0.5; and $m + n + o + p + q \approx 1$.

2. The resin as claimed in claim 1 wherein m has a value of 0.05 to 0.25, n has a value of 0.15 to 0.80, o has a value of 0.25 to 0.80, p has a value of 0.015 to 0.35, and q has a value of 0 to 0.15.

3. The resin as claimed in claim 1 wherein R' is H.

4. The resin as claimed in claim 1 wherein R is a carboxylic acid group having the formula $-R^2C(O)OH$, an ester having the formula $-R^2C(O)OR^3$, or a mixture thereof, where R^2 is selected from alkylene groups having 1 -10 carbon atoms and R^3 is a protecting group.

5. The resin as claimed in claim 4 wherein the protecting group is selected from t-butyl, trimethylsilyl, anhydride groups, methylthiomethyl ester, benzyloxymethyl ester, diphenylmethyl ester, p-methoxybenzyl ester.

6. A method for producing a silsesquioxane resin comprising reacting in an organic solvent

(A) a mixture of silane reactants comprising 0 to 90 mole% $Ph(CH_2)_rSiX_3$, 5 to 99 mole% $HSiX_3$ 0 to 95 mole% $MeSiX_3$, 1 to 95 mole% $RSiX_3$, and 0 to 50 mole%R^1SiX_3 with the proviso that the sum of silane reactants equals 100 mole%;

and

(B) 0.5 to 2 moles of water per mole of X in the silane reactants wherein Ph represents a phenyl group, Me represents a methyl group, R is selected from a carboxylic acid group, a carboxylic acid forming group or a mixture thereof; and R^1 is selected from substituted phenyl groups, ester groups, polyether groups; mercapto groups, sulfur-containing organic functional groups, hydroxyl producing group, aryl sulphonic ester groups, and reactive or curable organic functional groups; and r has a value of 0, 1, 2, 3, or 4; and X is a hydrolyzable group,

further optionally comprising adding

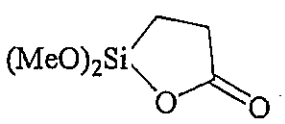
(C) 0.05 to 1 wt% of a catalyst based on the weight of (A) + (B).

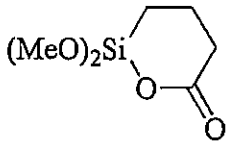
7. The method as claimed in claim 6 wherein $RSiX_3$ is selected from

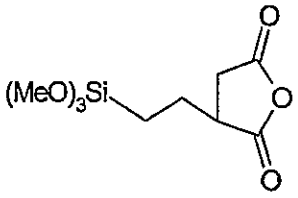
$(MeO)_3Si\text{-}(CH_2)_m\text{-}(OCH_2CH_2)_n\text{-}COO^tBu$

$(MeO)_3Si\text{-}(CH_2)_2\text{-}COO\text{-}SiMe_3$

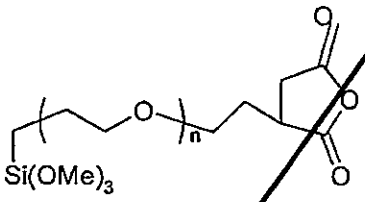
$(MeO)_3Si\text{-}(CH_2)_m\text{-}(OCH_2CH_2)_n\text{-}COO\text{-}SiMe_3$







and



wherein Me is a methyl group, ^tBu is a t-butyl group, m has a value of 2 or 3 and n has a value of 1 to 10.

8. The method as claimed in claim 6 wherein the organic solvent is present in an amount of 1 to 99 wt% based on the weight of (A) + (B).

9. The method as claimed in claim 8 wherein the organic solvent is selected from saturated aliphatics, cycloaliphatics, aromatics, ethers, ketones, halogen substituted alkanes, halogenated aromatics, esters and silicones.

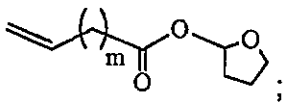
10. A method for producing a silsesquioxane resin comprising grafting a carboxylate olefin onto a Si-H containing silsesquioxane resin in the presence of a transition metal catalyst,

wherein the carboxylate olefin is selected from

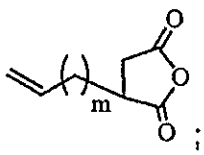
$CH_2=CH-(CH_2)_m-COOR^4$;

$CH_2=CH-(CH_2)_m-COO-CH_2-OMe$;

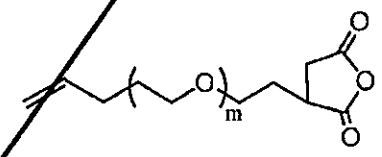
$CH_2=CH-(CH_2)_m-(OCH_2CH_2)_n-COOR^4$;



;



; and



where R^4 is selected from ^{t}Bu, $SiMe_3$, Si^tBuMe_2, or CPh_3; and m = 0 to 8.

11. The method as claimed in 10 wherein the SiH containing silsesquioxane resin is comprised of the units

$(Ph(CH_2)_rSiO_{(3-x)/2}(OR')_x)_m$

$(HSiO_{(3-x)/2}(OR')_x)_n$

$(MeSiO_{(3-x)/2}(OR')_x)_o$

$(R^1SiO_{(3-x)/2}(OR')_x)_q$

where Ph is a phenyl group, Me is a methyl group; R' is hydrogen atom or a hydrocarbon group having from 1 to 4 carbon atoms; and R^1 is selected from substituted phenyl groups, ester groups, polyether groups; mercapto groups, sulfur-containing organic functional groups, hydroxyl producing group, aryl sulphonic ester groups, and reactive or curable organic functional groups; and r has a value of 0, 1, 2, 3, or 4; x has a value of 0, 1

or 2; wherein in the resin m has a value of 0 to 0.90; n" has a value of 0.10 to 1; o has a value of 0 to 0.95; q has a value of 0 to 0.5; and m + n' + o + q ≈ 1.

12. The method as claimed in claim 10 wherein the transition metal catalyst is a platinum catalyst.

13. An antireflective coating (ARC) composition comprising

(i) silsesquioxane resin comprised of the units

$(Ph(CH_2)_rSiO_{(3-x)/2}(OR')_x)_m$

$(HSiO_{(3-x)/2}(OR')_x)_n$

$(MeSiO_{(3-x)/2}(OR')_x)_o$

$(RSiO_{(3-x)/2}(OR')_x)_p$

$(R^1SiO_{(3-x)/2}(OR')_x)_q$

where Ph is a phenyl group, Me is a methyl group; R' is hydrogen atom or a hydrocarbon group having from 1 to 4 carbon atoms; R is selected from a carboxylic acid group, a carboxylic acid forming group or mixtures thereof; and R^1 is selected from substituted phenyl groups, ester groups, polyether groups; mercapto groups, sulfur-containing organic functional groups, hydroxyl producing group, aryl sulphonic ester groups, and reactive or curable organic functional groups; and r has a value of 0, 1, 2, 3, or 4; x has a value of 0, 1 or 2; wherein in the resin m has a value of >0 to 0.90; n has a value of 0.05 to 0.99; o has a value of 0 to 0.95; p has a value of 0.01 to 0.5; q has a value of 0 to 0.5; and m + n + o + p + q ≈ 1.; and (ii) a solvent.

14. The ARC composition as claimed in claim 13 wherein there is 10% to 99.9 wt% solvent based on the total weight of the ARC composition.

15. The ARC composition as claimed in claim 13 wherein the solvent is selected from 1-methoxy-2-propanol, propylene glycol monomethyl ethyl acetate gamma-butyrolactone, and cyclohexanone.

CLAIMS

1. A silsesquioxane resin wherein the silsesquioxane resin is comprised of the units

$(Ph(CH_2)_rSiO_{(3-x)/2}(OR')_x)_m$

$(HSiO_{(3-x)/2}(OR')_x)_n$

$(MeSiO_{(3-x)/2}(OR')_x)_o$

$(RSiO_{(3-x)/2}(OR')_x)_p$

$(R^1SiO_{(3-x)/2}(OR')_x)_q$

where Ph is a phenyl group, Me is a methyl group; R' is hydrogen atom or a hydrocarbon group having from 1 to 4 carbon atoms; R is selected from a carboxylic acid group having the formula $-R^2C(O)OH$, an ester having the formula $-R^2C(O)OR^3$ or mixtures thereof where R^2 is selected from alkylene groups having 1 -10 carbon atoms and R^3 is a protecting group selected from t-butyl, trimethylsilyl, anhydride groups, methylthiomethyl ester, benzyloxymethyl ester, diphenylmethyl ester, p-methoxybenzyl ester; and R^1 is selected from substituted phenyl groups, ester groups, polyether groups; mercapto groups, sulfur-containing organic functional groups, hydroxyl producing group, aryl sulphonic ester groups, and reactive or curable organic functional groups; and r has a value of 0, 1, 2, 3, or 4; x has a value of 0, 1 or 2; wherein in the resin m has a value of 0 to 0.90; n has a value of 0.05 to 0.99; o has a value of 0 to 0.95; p has a value of 0.01 to 0.5; q has a value of 0 to 0.5; and $m + n + o + p + q \approx 1$.

2. The resin as claimed in claim 1 wherein m has a value of 0.05 to 0.25, n has a value of 0.15 to 0.80, o has a value of 0.25 to 0.80, p has a value of 0.015 to 0.35, and q has a value of 0 to 0.15.

3. The resin as claimed in claim 1 wherein R' is H.

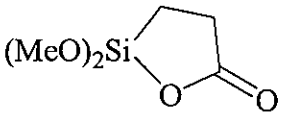
4. A method for producing a silsesquioxane resin comprising reacting in an organic solvent

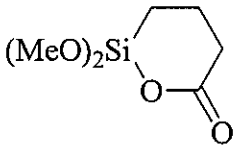
(A) a mixture of silane reactants comprising 0 to 90 mole% $Ph(CH_2)_rSiX_3$, 5 to 99 mole% $HSiX_3$, 0 to 95 mole% $MeSiX_3$, 0 to 50 mole%R^1SiX_3 and 1 to 95 mole% of a compound selected from

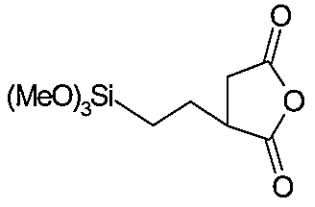
$(MeO)_3Si\text{-}(CH_2)_m\text{-}(OCH_2CH_2)_n\text{-}COO^tBu$

$(MeO)_3Si\text{-}(CH_2)_2\text{-}COO\text{-}SiMe_3$

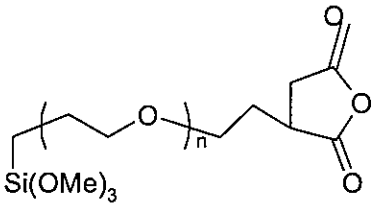
$(MeO)_3Si\text{-}(CH_2)_m\text{-}(OCH_2CH_2)_n\text{-}COO\text{-}SiMe_3$







and



wherein Me is a methyl group, ^{t}Bu is a t-butyl group, m has a value of 2 or 3 and n has a value of 1 to 10,

with the proviso that the sum of silane reactants equals 100 mole%; and (B) 0.5 to 2 moles of water per mole of X in the silane reactants wherein Ph represents a phenyl group, Me represents a methyl group, R^1 is selected from substituted phenyl groups, ester groups, polyether groups; mercapto groups, sulfur-containing organic functional groups,

hydroxyl producing group, aryl sulphonic ester groups, and reactive or curable organic functional groups; and r has a value of 0, 1, 2, 3, or 4; and X is a hydrolyzable group,

further optionally comprising adding

(C) 0.05 to 1 wt% of a catalyst based on the weight of (A) + (B) .

5. The method as claimed in claim 4 wherein the organic solvent is present in an amount of 1 to 99 wt% based on the weight of (A) + (B).

6. The method as claimed in claim 5 wherein the organic solvent is selected from saturated aliphatics, cycloaliphatics, aromatics, ethers, ketones, halogen substituted alkanes, halogenated aromatics, esters and silicones.

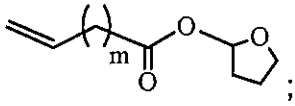
7. A method for producing a silsesquioxane resin comprising grafting a carboxylate olefin onto a Si-H containing silsesquioxane resin in the presence of a transition metal catalyst,

wherein the carboxylate olefin is selected from

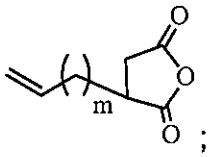
$CH_2=CH-(CH_2)_m-COOR^4$;

$CH_2=CH-(CH_2)_m-COO-CH_2-OMe$;

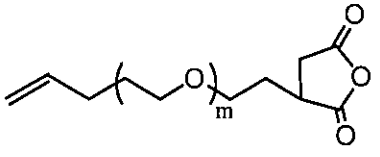
$CH_2=CH-(CH_2)_m-(OCH_2CH_2)_n-COOR^4$;



;



; and



where R^4 is selected from ^{t}Bu, $SiMe_3$, Si^tBuMe_2, or CPh_3; and m = 0 to 8.

8. The method as claimed in 7 wherein the SiH containing silsesquioxane resin is comprised of the units

$(Ph(CH_2)_rSiO_{(3-x)/2}(OR')_x)_m$
$(HSiO_{(3-x)/2}(OR')_x)_{n"}$
$(MeSiO_{(3-x)/2}(OR')_x)_o$
$(R^1SiO_{(3-x)/2}(OR')_x)_q$

where Ph is a phenyl group, Me is a methyl group; R' is hydrogen atom or a hydrocarbon group having from 1 to 4 carbon atoms; and R^1 is selected from substituted phenyl groups, ester groups, polyether groups; mercapto groups, sulfur-containing organic functional groups, hydroxyl producing group, aryl sulphonic ester groups, and reactive or curable organic functional groups; and r has a value of 0, 1, 2, 3, or 4; x has a value of 0, 1 or 2; wherein in the resin m has a value of 0 to 0.90; n" has a value of 0.10 to 1; o has a value of 0 to 0.95; q has a value of 0 to 0.5; and $m + n" + o + q \approx 1$.

9. The method as claimed in claim 7 wherein the transition metal catalyst is a platinum catalyst.

10. An antireflective coating (ARC) composition comprising

(i) silsesquioxane resin comprised of the units

$(Ph(CH_2)_rSiO_{(3-x)/2}(OR')_x)_m$
$(HSiO_{(3-x)/2}(OR')_x)_n$
$(MeSiO_{(3-x)/2}(OR')_x)_o$
$(RSiO_{(3-x)/2}(OR')_x)_p$
$(R^1SiO_{(3-x)/2}(OR')_x)_q$

where Ph is a phenyl group, Me is a methyl group; R' is hydrogen atom or a hydrocarbon group having from 1 to 4 carbon atoms; R is selected from a carboxylic acid group having the formula $-R^2C(O)OH$, an ester having the formula $-R^2C(O)OR^3$ or mixtures thereof where R^2 is selected from alkylene groups having 1 -10 carbon atoms and R^3 is a protecting group selected from t-butyl, trimethylsilyl, anhydride groups, methylthiomethyl ester, benzyloxymethyl ester, diphenylmethyl ester, p-methoxybenzyl ester; and R^1 is selected from substituted phenyl groups, ester groups, polyether groups; mercapto groups, sulfur-containing organic functional groups, hydroxyl producing group, aryl sulphonic ester groups, and reactive or curable organic functional groups; and r has a value of 0, 1, 2, 3, or 4; x has a value of 0, 1 or 2; wherein in the resin m has a value of >0 to 0.90; n has a value of 0.05 to 0.99; o has a value of 0 to 0.95; p has a value of 0.01 to 0.5; q has a value of 0 to 0.5; and $m + n + o + p + q \approx 1$; and (ii) a solvent.

11. The ARC composition as claimed in claim 10 wherein there is 10% to 99.9 wt% solvent based on the total weight of the ARC composition.

12. The ARC composition as claimed in claim 10 wherein the solvent is selected from 1-methoxy-2-propanol, propylene glycol monomethyl ethyl acetate gamma-butyrolactone, and cyclohexanone.