$R^4$ is $C_1$-$C_6$ alkyl or cycloalkyl, or -$R^5$-Si($Y_p$)($R^6$)$_{3-p}$, or ($R_m$)$_x$-$R^1$-$X^2$-C(O)-$CH_2CH_2$-,

$R^5$ is a divalent alkylene group, said alkylene groups optionally containing one or more catenary oxygen or nitrogen atoms,

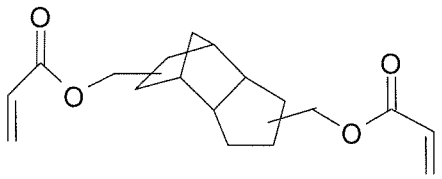
Y is a hydrolysable group selected from alkoxy groups, acetate groups, aryloxy groups, and halogens,

$R^6$ is a monovalent alkyl or aryl group, and

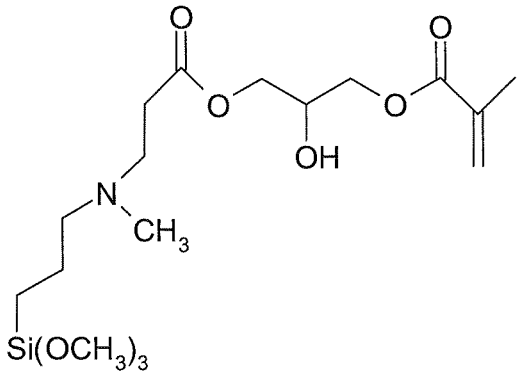
p is 1,2, or 3.

4. The barrier film of any preceding claim, wherein the first and second (meth)acryloyl compound are selected from the group consisting of tricyclodecanedimethanol di(meth)acrylate, 3-(acryloxy)-2-hydroxy-propylmeth(meth)acrylate, triacryloxyethyl isocyanurate, glycerol di(meth)acrylate, ethoxylated trimethylolpropane di(meth)acrylate, pentaerythritol tri(meth)acrylate, propoxylated (3) glyceryl di(meth)acrylate, propoxylated (5,5) glyceryl di(meth)acrylate, propoxylated (3) trimethylolpropane di(meth)acrylate, propoxylated (6) trimethylolpropane di(meth)acrylate), trimethylolpropane di(meth)acrylate, di-trimethylolpropane tetra(meth)acrylate, dipentaerythritol penta(meth)acrylate, and combinations thereof.

5. The barrier film of any one of claims 1 to 3, wherein the (meth)acryloyl compound is:



and the (meth)acryl-silane compound is at least one of:



or

11. A process for making a barrier film, comprising:

(a) applying a base (co)polymer layer to a major surface of a substrate;

(b) applying an oxide layer on the base (co)polymer layer; and

(c) depositing on the oxide layer a first (meth)acryloyl compound and a (meth)acryl-silane compound derived from a Michael reaction between a second (meth)acryloyl compound and an aminosilane, and reacting the (meth)acryl-silane compound with the first (meth)acryloyl compound to form a protective (co)polymer layer on the oxide layer.

12. The process of claim 11, wherein step (a) comprises:

(i) evaporating a base (co)polymer precursor;

(ii) condensing the evaporated base (co)polymer precursor onto the substrate; and

(iii) curing the evaporated base (co)polymer precursor to form the base (co)polymer layer.

13. The process of ~~any one of~~ claims ~~11~~-12, wherein the base (co)polymer precursor comprises a (meth)acrylate monomer.

14. The process of any one of claims 11-13, wherein step (b) comprises depositing an oxide onto the base (co)polymer layer to form the oxide layer, wherein depositing is achieved using sputter deposition, reactive sputtering, chemical vapor deposition, or a combination thereof.

15. The process of any one of claims 11-14, wherein step (b) comprises applying a layer of an inorganic silicon aluminum oxide to the base (co)polymer layer.

16. The process of any one of claims 11-15, further comprising sequentially repeating steps (b) and (c) to form a plurality of alternating layers of the protective (co)polymer layer and the oxide layer on the base (co)polymer layer.

17. The process of any one of claims 11-16, wherein step (c) further comprises at least one of co-evaporating the (meth)acryl-silane compound with the (meth)acryloyl compound from a liquid mixture, or sequentially evaporating the (meth)acryl-silane compound and the

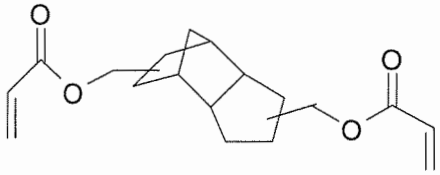
(meth)acryloyl compound from separate liquid sources, optionally wherein the liquid mixture comprises no more than about 10 wt. % of the (meth)acryl-silane.

18. The process of claim 17, wherein step (c) further comprises at least one of co-condensing the (meth)acryl-silane compound with the (meth)acryloyl compound onto the oxide layer, or sequentially condensing the (meth)acryl-silane compound and the (meth)acryloyl compound on the oxide layer.

19. The process of any one of claims 11-18, wherein reacting the (meth)acryloyl compound with the (meth)acryl-silane compound to form a protective (co)polymer layer on the oxide layer occurs at least in part on the oxide layer.

20. The process of any one of claims 11-19, further comprising applying an oxide layer to a top protective (co)polymer layer, optionally wherein the oxide layer comprises at least one of silicon aluminum oxide or indium tin oxide.

21. The barrier film of any one of claims 41 to 3, wherein the (meth)acryloyl compound is:



and the (meth)acryl-silane compound is selected from the group consisting of:

