

# Silane Surface Modifying Reagents

**John H. MacMillan Ph.D.**

Industrial silane suppliers offer a wide range of polar and non-polar silanes which may be used to modify the surface of substrates such as glass, silica, alumina, silicon and transition metals. The surface may be treated to decrease wettability or increase adhesion of the polymer to glass, silicon or metals. Such treatment may also allow differential polar or hydrophobic interactions. The hydrophobic class represents alkyl functional alkoxy or chlorosilanes from C2-C22 chain length. They find use in decreasing the wettability of treated surfaces, as releasing agents and for increasing the hydrophobic interactions of treated sorbents with diluents in a mobile phase. The reactive class consists of alkoxy or chloro functional silanes with an additional chemically labile group such as epoxy, acryl, vinyl or mercapto. This labile group covalently bonds to active sites on elastomers or biopolymers while the functionalized silane bonds to the substrate, thus promoting adhesion. Polar reactive materials likewise are alkoxy or chlorosilyl functional but chemically labile at a non-silyl functionality which has the added ability to hydrogen bond or form ionic salts with polar diluents in a mobile phase. Sorbents such as silica or alumina when pretreated with these polar reactive materials may show differential hydrogen or ionic interactions with two or more polar diluents. Varying the pH to optimize differential polar or hydrophobic interactions with the treated sorbent often results in clean separations of complex drug or natural product mixtures. Both reactive and polar reactive classes have also found extensive application in promoting adhesion for elastomers used in the electronics and construction industries. Enhanced adhesion of proteins and nucleotides to glass or other substrates leads to extensive use of both reactive and polar reactive classes in biosensors and medical applications.

Below are tabulated representative samples from United Chemical Technologies, grouped by class. The trifunctional at silicon examples of each functionality are shown. Where a surface monolayer is required many mono chloro or alkoxy-silyl examples are also available. Searching online catalogs under the non-silyl functionality will reveal additional examples. Gelest, Silar and Aldrich Chemical also supply most of these materials.

<b>Class</b>	<b>Functionality</b>	<b>Cat#</b>	<b>Chemical Name</b>
Hydrophobic	C2	E6350	Ethyltrichlorosilane
Hydrophobic	C2	E6380	Ethyltriethoxysilane
Hydrophobic	C3	P0800	n-Propyltrichlorosilane
Hydrophobic	C3	P0810	n-Propyltrimethoxysilane
Hydrophobic	C4	B2850	n-Butyltrichlorosilane
Hydrophobic	C4	B2856	n-Butyltrimethoxysilane
Hydrophobic	C6	H7332	n-Hexyltrichlorosilane
Hydrophobic	C6	H7334	n-Hexyltrimethoxysilane

Hydrophobic	C8	O9830	n-Octyltrichlorosilane
Hydrophobic	C8	O9835	n-Octyltriethoxysilane
Hydrophobic	C10	D3795	n-Decyltrichlorosilane
Hydrophobic	C12	D6220	n-Dodecyltrichlorosilane
Hydrophobic	C12	D6221	n-Dodecyltriethoxysilane
Hydrophobic	C18	O9750	n-Octadecyltrichlorosilane
Hydrophobic	C18	O9775	n-Octadecyltriethoxysilane
Hydrophobic	C18	O9780	n-Octadecyltrimethoxysilane
Hydrophobic	C18	PS200	Glassclad-18
Hydrophobic	C20	E6240	n-Eicosyltrichlorosilane
Hydrophobic	C22	D6217	n-Docosyltrichlorosilane
Hydrophobic	Phenyl	P0280	Phenyltrichlorosilane
Hydrophobic	Phenyl	P0320	Phenyltriethoxysilane
Hydrophobic	Tridecafluorooctyl	T2492	(Tridecafluoro-1,1,2,2,-tetrahydrooctyl)-1-trichlorosilane
Hydrophobic	Tridecafluorooctyl	T2494	(Tridecafluoro-1,1,2,2,-tetrahydrooctyl)-1-triethoxysilane
Reactive	Acryl	A0396	3-Acryloxypropyltrichlorosilane
Reactive	Acryl	A0397	3-Acryloxypropyltrimethoxysilane
Reactive	Allyl	A0560	Allyltrichlorosilane
Reactive	Allyl	A0564	Allyltriethoxysilane
Reactive	Allyl	A0567	Allyltrimethoxysilane
Reactive	Bromo	B2615	3-Bromopropyltrichlorosilane
Reactive	Bromo	B2620	3-Bromopropyltrimethoxysilane
Reactive	Chlorobutyl	C2980	4-chlorobutyldimethylchlorosilane
Reactive	(Chloromethyl)phenyl	C3277	(p-Chloromethyl)phenyltrichlorosilane
Reactive	(Chloromethyl)phenyl	C3277.4	(p-Chloromethyl)phenyltrimethoxysilane
Reactive	(Chloromethyl)phenyl	T2902	1-Trimethoxysilyl-2-(m,p-chloromethyl)phenylethane
Reactive	Chloromethyl	C3280	Chloromethyltrichlorosilane
Reactive	Chloromethyl	C3281	Chloromethyltriethoxysilane
Reactive	Chloroethyl	C3150	2-Chloroethyltriethoxysilane
Reactive	Chloropropyl	C3291	3-Chloropropyltrichlorosilane
Reactive	Chloropropyl	C3300	3-Chloropropyltrimethoxysilane
Reactive	Epoxy	G6720	3-Glycidoxypropyltrimethoxysilane

Reactive	Iodopropyl	I7750	3-Iodopropyltrimethoxysilane
Reactive	Isocyanato	I7840	3-Isocyanatopropyltriethoxysilane
Reactive	Mercapto	M8500	3-Mercaptopropyltrimethoxysilane
Reactive	Mercapto	M8502	3-Mercaptopropyltriethoxysilane
Reactive	Phosphino	D6110	2-(Diphenylphosphino)ethyltriethoxysilane
Reactive	Vinyl	V4800	Vinyltriacetoxysilane
Reactive	Vinyl	V4900	Vinyltrichlorosilane
Reactive	Vinyl	V4910	Vinyltriethoxysilane
Reactive	Vinyl	V4917	Vinyltrimethoxysilane
Polar/reactive	Amide	T2507	N-(Triethoxysilylpropyl)urea
Polar/reactive	Amino	A0700	N-(2-Aminoethyl)-3-aminopropyl trimethoxysilane
Polar/reactive	Amino	A0750	3-Aminopropyltriethoxysilane
Polar/reactive	Amino	A0800	3-Aminopropytrimethoxysilane
Polar/reactive	Carbomethoxy	C2905	2-(Carbomethoxy)ethyltrichlorosilane
Polar/reactive	Carboxylic acid	T2913	N-[(3-Trimethoxysilyl)propyl]ethylenediamine triacetic acid trisodium salt
Polar/reactive	Cyano	C3555	3-Cyanopropyltrichlorosilane
Polar/reactive	Cyano	C3555.3	3-Cyanopropyltriethoxysilane
Polar/reactive	Chlorosulfonyl	C3355	2-(4-Chlorosulfonylphenyl)ethyltrichlorosilane
Polar/reactive	Chlorosulfonyl	C3360	2-(4-Chlorosulfonylphenyl)ethyltrimethoxysilane
Polar/reactive	Pyridyl	T2907	2-(Trimethoxysilyl)ethyl-2-pyridine
Polar/reactive	Pyrolle	T2923.5	N-(3-Trimethoxysilylpropyl)pyrolle
Polar/reactive	Quaternary Ammonium	O9745	N-Octadecyldimethyl-[(3-trimethoxysilyl)propyl]ammonium chloride
Polar/reactive	Ammonium	S1590	3-(N-Styrylmethyl-2-aminoethylamino)-propyl trimethoxysilane hydrochloride (40% in Methanol)
Polar/reactive	Quaternary Ammonium	T2925	N-Trimethoxysilylpropyl-N,N,N-trimethylammonium chloride