Surface Treatment of Particles with Silane Modified Amino Acids*

Gelest Skin Friendly "SF" Surface Treatment *patent pending

B. Arkles, Ph.D., Y. Pan, Ph. D., J. Hollenberg

Gelest PCS
Silicon Innovations for Cosmetics

ABSTRACT

A new biomimetic approach toward surface hydrophilicity in which naturally occurring amino acids are modified, enabling their reaction with the surfaces of particles and pigments, has been developed . The treated particles and pigments represent a new class of water-dispersible materials suitable for cosmetic formulation. Biomimetic surface treatments which render surfaces hydrophobic have also been developed.

BACKGROUND

In biological systems the hydrophilicity of proteins is modified by the incorporation of amino acids with various degrees of polarity into the protein. They effect a permanence to the wettabilty and surface properties of proteins. Unlike naturally occurring systems, the utilization of amino acids to modify the surface of particles lacks permanence due to the absence of covalent bonds to anchor the amino acids to the surface. To date, durable hydrophilic surface treatments are generally wholly synthetic.

Similar to other alkoxysilanes, the silane modified amino acids react with surface hydroxyl groups, forming a permanent coating which does not dissolve off during processing, even at elevated temperatures. In contrast to materials coated with lipophilic derivatives of amino acids, particles treated with silane modified amino acids can be hydrophilic, forming stable dispersions in aqueous systems.

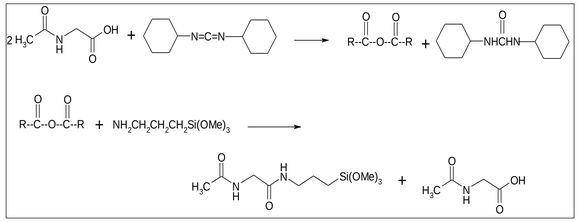
SCC Technical Showcase
December 9-10, 2010

AMINO ACID FUNCTIONAL SILANES

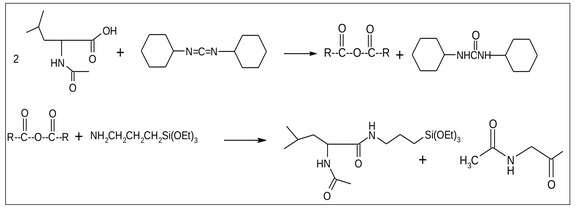
SYNTHESIS: Dehydrative coupling
Alkoxysilanemodified amino acids were synthesized to provide a means to covalently bond amino acids to the surface of cosmetic pigments and fillers. Two different pathways for synthesis were investigated.

The general synthetic method for formation of the peptidic amide involves a dehydrative coupling with dicyclohexylcarbodiimide (DCCU), a strong sensitizing agent that often causes skin rashes.

3-(N-Acetylglycinamide)propyltrimethoxysilane



3-(N-Acetylleucinamide)propyltriethoxysilane



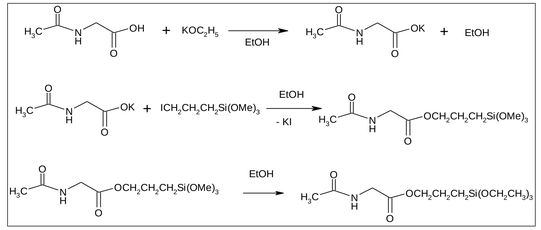
While initial positive results were shown with silanes having an amide transition between the amino acid and silane centers, there were concerns relating to the need to eliminate even trace amounts of DCCU from the final product.

AMINO ACID FUNCTIONAL SILANES

SYNTHESIS: Salt elimination

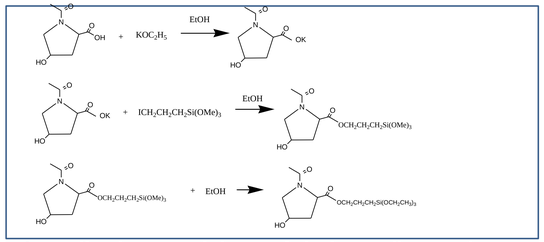
To avoid the use of DCCU, a salt elimination reaction leading to the ester products was preferred for commercial products for topical application, using only "safe" synthetic reagents

3-(N-Acetylglycylpropyl)triethoxysilane



Glycine functional silanes impart surface hydrophilicity and aqueous dispersibility to treated particles

3-(N-Acetylhydroxyprolylpropyl)triethoxysilane



Acetylhydroxyprolylpropyltriethoxysilane, also hydrophilic, imparted a number of useful properties when used as a pigment surface treatment:

- reduction in dryness,
- increased affinity to the skin.
- improvement in skin feel

A component of collagen, hydroxyproline provides the skin and hair with moisture retention, firmness, and elasticity.

FORMULATIONS

Used in **water based mascara,** acetyl hydroxyprolylpropyltriethoxysilane treated pigments have affinity for the lashes, aiding formula adhesion and providing enhanced lash building and conditioning.

Mascara	
Deionized water	62.84
Butylene Glycol	6.00
Methylparaben	0.30
Tris Amino (Tromethamine)	1.00
Deionized Water	4.00
Shellac (Mantrose-Haeusner)	1.00
Black Iron Oxide SF (Gelest) Iron Oxides, acetyl hydroxy-prolylpropyltriethoxysilane	10.00
Natrosol 250 MR (Hydroxyethylcellulose)	0.50
White Beeswax (Strahl&Pitsch)	6.00
Carnauba Wax (Strahl&Pitsch)	4.40
Alfol 16 (Cetyl Alcohol, Sasol)	2.00
Span 60 (Sorbitan Stearate, Croda)	1.00
Panalane H-300 E (Hydrogenated Polyisobutene, Lipo)	0.50
Propylparaben	0.10
Glydant (DMDM Hydantoin, Lonza)	0.36
	100.00

Oil in water foundation formulations prepared with acetyl hydroxyprolylpropyltriethoxysilane modified pigments apply smoothly and dry down to a soft "second skin", giving a natural appearance and long wearing color that does not change over time.

Foundation	
Deionized Water	
Tween 60 (Polysorbate 60, Croda)	0.10
Laponite XLG (NaMgAl Silicate, Southern Clay)	0.20
Veegum (MgAl Silicate, Vanderbilt)	0.80
SF pigments treated with Acetylhydroxyprolylpropyltriethoxysilane :	
Titanium Dioxide SF (Gelest)	16.00
Yellow Iron Oxide SF (Gelest)	1.60
Red Iron Oxide SF (Gelest)	0.60
Black Iron Oxide SF (Gelest)	0.16
Talc SF (Gelest)	1.64
Butylene Glycol	4.00
CMC7H3SF (Cellulose Gum)	0.10
Tween 60	0.40
Butylene Glycol	2.00
Amphisol K	2.00
DE 12 (Polydiethylsiloxane, Gelest)	8.00
Ceraphyl 368 (EthylhexylPalmitate, ISP)	5.00
Span 60 (Sorbitan Stearate, Croda0	1.00
Cerasynt SD (Glycery lStearate, ISP)	1.50
SID 2650.0 (Cyclopentasiloxane, Gelest,)	4.00
Phenoxetol (Phenoxyethanol, Clariant)	0.70
Hydrolite CG (Caprylyl Glycol, Symrise)	0.50
	100.00