PolyFacts

Vol. 4 | No. 1

Monomers & Polymers

News | Views | Insights *from* Polysciences, Inc. Chemistry beyond the ordinary

IN THIS ISSUE. . .

New

Thiol-SAMMS® Metal Scavenger Kit

Silica based "precious metal" recovery system for heavy metal scavenging of heterogeneous or homogeneous catalysts.

See page 4 for details

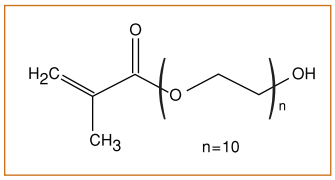
New Hydrophilic Monomers

Polysciences, Inc. Announces the Availability of a Series of Hydrophilic Monomers for Research Applications

Introduction of hydrophilic properties into polymers is required in applications where higher water and oxygen transmission rates are desirable without sacrificing basic mechanical or physical properties of the polymer backbone. This property balancing act is particularly critical in end uses such as optical lenses, membranes, biomedical devices (e.g. topical dermal patches), breathable coatings and other high value-added applications.

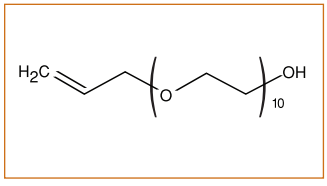
Hydroxyl Functional Monomers

(HEMA-10) Poly Ethoxy (10) ethyl methacrylate *(CAS # 25736-86-1)*



This homolog of HEMA bears 10 ethoxy units on the ester linkage. These water soluble pendant, non-ionic side chains not only increase water compatibility in the polymer but can enhance stabilization of latex systems alone or in combination with added non-ionic surfactants.

Hydroxypolyethoxy (10) Allyl Ether *(CAS # 27274-31-3)*



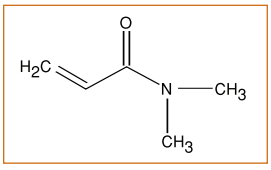
Where ester groups are undesirable due to hydrolytic conditions, allyl ethers may be useful in vinyl polymerizations through the allylic olefin to impart hydrophilic properties in aqueous solution or emulsion polymers.

These higher homologs are extensions of the Polysciences, Inc. hydroxyethyl methacrylate-HEMA *(Cat. # 04675)* currently available as a high purity optical monomer.

Physical Property Profiles of Ethoxylated Monomers

	(HEMA 10) Poly Ethoxy (10) ethyl methacrylate	Hydroxypolyethoxy (10) Allyl Ether
Molecular Weight	526	498
Ethylene oxide, moles	10	10
Active Content (%)	90	99
Moisture Content (%)	0.5	0.2
Hydroxyl number (meq KOH/mg)	98	115
Inhibitor (p-benzophenone; ppm)	800	—
Appearance	Viscous Liquid	Low Viscosity Liquid

N, N-Dimethylacrylamide, 99.9% *(CAS # 2680-03-7)*



Amido functional monomers increase hydrophilic properties and copolymerize well into a range of acrylate and methacrylate systems. This exceptionally high purity monomer is ideal for research in optical lens applications.

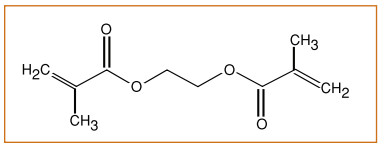
Physical Property Profile of N, N-Dimethylacrylamide

Molecular Weight	99
Purity (%)	99.9
Water (%)	0.1
Inhibitor (MEHQ, ppm)	50
Appearance	Clear Liquid

Continues on page 2

New Hydrophilic Monomers

Ethylene Glycol Dimethacrylate, 99.7% *(CAS # 97-90-5)*



Where crosslinking of acrylate or methacrylate polymers is required to achieve a porous network structure, ethlene glycol dimethacrylate may be used as a high purity crosslinker with bridging/spacing capability between polymer chains.

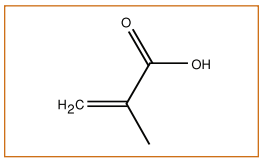
Physical Property Profile of Ethylene Glycol Dimethacrylate

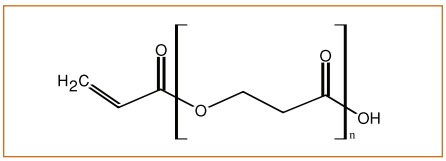
Molecular Weight: 198	Moisture (%): 0.03
Purity (%): 99.7	Inhibitor (MEHQ, ppm): 50
2-hydroxyethylmethacrylate (%): 0.3	Appearance: Clear Liquid

Acid Functional Monomers

Methacrylic Acid, 99.9% *(CAS # 79-41-4)*
Beta-Carboxyethyl Acrylate, 99% *(CAS # 24615-84-7)*

High purity carboxylated monomers increase the hydrophilicity in polymers and provide crosslinking sites for divalent ions (e.g. Zn^{++}). Polysciences, Inc. offers both methacrylic acid in high purity (99.9%) and a longer chain analog, Beta-Carboxyethyl acrylate (99%).



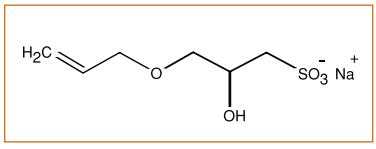


Physical Property Profiles of Acid Functional Monomers

	Methacrylic Acid	Beta-Carboxyethyl Acrylate
CAS #	79-41-4	24615-84-7
Molecular Weight	86	144
Purity (%)	99.9	99
Moisture (%)	0.05	0.70
Inhibitor (MEHQ, ppm)	200	1,000
Appearance	Clear Liquid	Slightly Viscous Liquid

Sulfonated Monomer

Sodium 1-Allyloxy-2 hydroxypropyl Sulfonate *(CAS # 52556-42-0)*



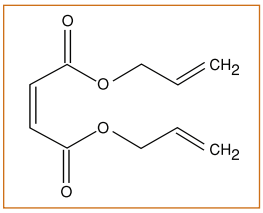
Sodium salt of the allyl ether sulfonate. It readily undergoes vinyl polymerization reactions in aqueous or emulsion systems and provides a bound source of anionically charged sulfonate groups in a polymer backbone. Anionic charge assists in latex particle stabilization in low surfactant systems but also aids in downstream formulation work to avoid the addition of high levels of excess surfactants for formulation stabilization. This improves water resistance in formulations and provides low foaming properties.

Physical Property Profile of Sodium 1-Allyloxy-2-hydroxypropyl Sulfonate

Molecular Weight: 218	Water (%): 60
Active Polymer (% in aq. sol.): 40	pH (10% in water): 7.5

Other Specialty Monomers

Diallyl Maleate *(CAS # 99-21-3)*

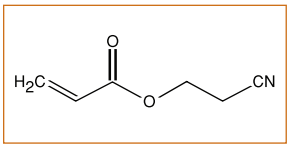


Diallyl ester of maleic acid. Once polymerized through the vinyl center adjacent to the ester groups, it provides multiple post-functionalization target sites at the pendant allylic centers. This makes it particularly useful both in acrylic chemistry but also in combination with alkyd and polyester resins. When employed at very low levels it is an effective site for branching generation in emulsion polymers.

Physical Property Profile of Diallyl Maleate

Molecular Weight: 196	Moisture (%): 0.05
Active Monomer (%): 99	Appearance: Clear Liquid
Acidity Value (meq/gm): 0.1	

2-Cyanoethyl Acrylate *(CAS # 106-71-8)*

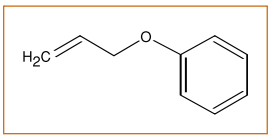


Used in a wide range of applications including photocurable resists for liquid crystal devices, photocurable polymer insulators for multilayer circuitry, electroluminescent products, graft polymers for controlled diffusion, vulcanization of rubbers and as an adhesion promoter. It is not to be confused with the alpha-cyano ethyl acrylate which is used in some Super Glue® products.

Physical Property Profile of 2-Cyanoethyl Acrylate

Molecular Weight: 125	Moisture (%): 0.2
Active Monomer (%): 92	Inhibitor (HQ, ppm): 700
Acidity Value (meq/gm): 0.03	Appearance: Light Yellow Liquid

Allyl Phenyl Ether, 98% *(CAS # 1746-13-0)*



High purity monomer which has a high refractive index allowing it to be used as a synthon in modifying polymer refractive index properties.

Physical Property Profile of Allyl Phenyl Ether

Molecular Weight: 134	Specific Gravity (20°C): 0.97
Purity (%): 98	Refractive Index (20°C): 1.52
Boiling Point (C): 185	Appearance: Amber Liquid

Description	CAS #	Cat. #	Size
(HEMA 10) Poly Ethoxy (10) ethyl methacrylate	25736-86-1	24890	100g
Hydroxypolyethoxy(10) Allyl Ether	27274-31-3	24899	100g
Ethylene Glycol Dimethacrylate, 99.7%	97-90-5	24896	250g
N, N-Dimethylacrylamide	2680-03-7	24895	100g
Methacrylic Acid, 99.9%	79-41-4	24897	250g
Beta-Carboxyethyl Acrylate, 99%	24615-84-7	24891	100g
Sodium 1-Allyloxy-2 hydroxypropyl Sulfonate	52556-42-0	24898	100g
Diallyl Maleate	99-21-3	24892	100g
2-Cyanoethyl Acrylate	106-71-8	24893	100g
Allyl Phenyl Ether, 98%	1746-13-0	24894	100g

U.S. & Canada: (800) 523-2575 / (215) 343-6484 **Fax:** (800) 343-3291 / (215) 343-0214 **email:** info@polysciences.com

Labeling of Polymers "Looking for Trouble"

The title is not designed to highlight how you can get into trouble by labeling polymers *(although some may disagree)*. Rather, this article is about how labeled polymers can serve as sentinels or beacons to determine when trouble is near. There are numerous technical references and articles where labeled, tagged or UV active polymers have been used to detect or otherwise signal the presence of alien compounds. There are also a variety of other types of light emitters such as Quantum Dots, Organic Light Emitting Diodes (OLEDs) and electroluminescent compounds but this brief overview focuses on some intentionally functionalized synthetic polymers that can act as signaling agents.

Fluorescence in Polymers

One of the recent collated references on fluorescent polymers is entitled "Fluorescence of Supermolecules, Polymers and Nanosystems." *(Springer Series on Fluorescence, Vol, 4, M.N. Berberan-Santos-editor, XVIII, 2008)*

Synthetic acrylic polymers (e.g. polyacrylates and polymethacrylates) are uniquely versatile in their ability to accommodate the introduction of fluorescent acrylic monomer probes. The reactivity ratios of acrylate type fluorescent monomers means they incorporate well into acrylate or methacrylate polymers and can be tailored to have different excitation and emission maximum. These capabilities are useful in studying the mobility of polymers in matrices, chain to chain interactions between polymers and for monitoring the type of environment the fluorescent probe sees during solution experiments or when included in cellular structures.

Fluorescent Microgel Thermometers

Reports of the synthesis of poly(N-isopropylacrylamide) labeled with a polarity responsive fluorescent monomer (benzofurazan molecule DBD-AE) have been designed to create fluorescent molecular thermometers. Once the temperature threshold in a solution of the microgel particles is reached, the particles fluoresce strongly.

(Iwai et. al., J. Mater. Chem., 15, 2796-2800, 2005)

Medical Imaging

The use of fluorescing polymers is increasing in importance for monitoring the drug release from implantable polymers in medical imaging. A series of biodegradable polymers including poly(ethylene glycol-(L) lactic acid) and polycaprolactone-PEG blends were studied with inherently fluorescing anticancer drugs such as topotecan and camptothecin. Using Fluorescence Lifetime Imaging Microscopy (FLIM), the release of the cancer drugs from the polymer in phosphate buffered saline were examined.

(Nowaczyk et. al. at www.aapsj.org/abstracts/AM_1999/2206.htm)

Weapons against Cancer

Researchers at the University of Michigan are taking a unique approach to treating cancer. Dendrimers (multi-pronged star shaped polymers) growing off the surface of gold nanoparticles (3 nm particles) may be functionalized with folic acid/fluorescent probes and anticancer drugs. Since cancer cells have many more folic acid receptors, they bind to the dendrimer folate sites engulfing the gold nanoparticles with the imaging probes and the cancer drug. The fluorescent dye permits microscopic visualization inside the cell.

(Dr. James Baker et. al. 'Small', July 2007 edition)

Biodegradable poly(lactic/glycolic acids)

Amino fluorescein has been used to couple with acid groups of biodegradable polymers rendering them visible during the degradation process. Using 5-amino fluoresceinamine, a 50:50 poly(lactic acid-glycolic acid) copolymer with free carboxylic acid was tagged. Lyophilization of the resulting polymer provides a labeled polymer whose rate of degradation and size of hydrolysis fragments can be tracked.

(Stracke et. al. Journal of Investigative Dermatology, 126, page 2224, 2006)

Detecting Chemical Agents

Georgia Institute of Technology researchers have focused on using modified PPEs (poly paraphenylene ethynylene) which have inherent fluorescence to detect the presence of chemical agents such as cholera and anthrax. Fluorescent polymers will also detect peroxides which are often used in explosive devices.

(Sanchez and Trogler, J. Mater. Chem., 18, 5134, 2008)

Story continues, page 4

Description	Cat. #	Excitation / Emission
Fluorescent Monomers		
3, 8 dimethyl acryloyl ethidium bromide	23590	439nm / 512nm
Methacryloxyethyl thiocarbamoyl rhodamine B	23591	548nm / 570nm
9-anthracenyl methyl methacrylate	23587	362nm / 407nm
Fluorescein dimethacrylate	23589	470nm / 511nm
Fluorescein isothiocyanate (FITC)	00373	488nm / 520nm
O-methacryloyl Hoechst 33258	23592	355nm / 497nm
2-Napthyl acrylate	06024	—
2-Napthyl methacrylate	23602	285nm / 345nm
1-Pyrenyl methyl methacrylate	23588	339nm / 394nm
Fluorescent Polystyrene Microparticles		
Fluoresbrite® Multifluorescent (1µ)	24062	multiple, see website
Fluoresbrite® Polychromatic Red (1µ)	18660	491, 512nm / 554nm
Fluoresbrite® Yellow Green (1µ)	17154	441nm / 486nm
Fluoresbrite® Carboxylated Bright Blue (1µ)	17458	360nm / 407nm
Fluoresbrite® Carboxylated Yellow Green (1µ)	15702	441nm / 486nm
Fluoresbrite® Carboxylated Yellow Orange (1µ)	18449	529nm / 546nm
Fluorescent Dyes (Squaraine Rotaxane type) for Conjugation Labeling		
SR Fluor™ 680 Carboxylate	24863	650nm / 678 nm
SR Fluor™ 680 NHS Ester	24866	650nm / 678nm (DMSO)
SR Fluor™ 680 Maleimide	24865	641nm / 664nm (Ethanol)
SR Fluor™ 680 Crown	24864	641nm / 661nm (Ethanol)
SR Fluor™ 680 Phenyl	24862	650nm / 678nm (DMSO)

Partial summary of fluorescent products. For further information and/or quotation on custom synthesis of labeled polymers please contact us or visit www.polysciences.com

New Thiol-SAMMS® Metal Scavenger Kit

Polysciences, Inc. now offers the latest in silica based "precious metal" recovery systems for heavy metal scavenging of heterogeneous or homogeneous catalysts.

Thiol-SAMMS®* stands for "**S**elf **A**ssembled **M**onolayers on **M**esoporous **S**upport." Molecularly engineered mesoporous functionalized silica has the unique ability to bind palladium and other precious metals. The high surface area and functional thiol binding sites give the Thiol-SAMMS® tremendous capacity and kinetics to absorb such metals very quickly in catalyzed reactions.

Advantages of Thiol-SAMMS® technology:

- Adsorption of 99% of targeted metals in minutes
- Capacity up to 60% of SAMMS® weight
- Operational over a wide pH range (pH 2-12)
- Meets the requirements of TCLP *(EPA Toxicity Characteristic Leaching Procedure)*
- Allows for the reclamation of metals and adsorbents

Polysciences, Inc. offers a test kit for quick sample evaluations that includes THMS-03 (100 grams) and THMS-M1 (100 grams) for testing of laboratory scale waste stream removal.

For convenience in laboratory scale testing, Polysciences, Inc. also offers a rare earth block magnet (Neodymium-Iron-Boron) or our BioMag® Multi-SEP Magnetic separator magnet that will accommodate test tubes for metal separation.

(L) Thiol-SAMMS® Kit. (R) Magnified surface and pore geometry of Thiol-SAMMS® Yellow spheres represent Thiol groups attached to the high surface area and inner surfaces of its pores. Purple balls represent the palladium or precious metal being adsorbed.

All materials are commercially available in bulk quantities, please call for quotation.

Description	Cat. #	Size
Thiol-SAMMS® Kit	24886	1 Kit
Neodymium Iron Magnet Unit	19772	1 each
BioMag® MultiSep Magnetic Separator	85200	1 each

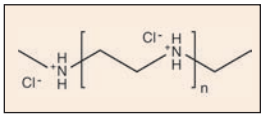
** Thiol-SAMMS® technology is supplied by Polysciences, Inc. under agreement with Steward Environmental Solutions, Chattanooga, TN*

New High Potency Linear Polyethylenimine "Max"

New Molecular Weight 4,000*

(Equivalent to Mw ~2,500 in free base form)

Cationic polymers with free nitrogen groups are difficult to produce from cationic monomers with unprotected amine groups as the starting materials.



Polysciences' current range of linear polyethylenimines are offered in three molecular weights; 2,500, 25,000 and 250,000.

Polysciences, Inc. is pleased to announce the availability of a new molecular weight of a virtually fully hydrolyzed linear polyethylenimine with longer contiguous ethylenimine segments. Our material is supplied as a hydrochloride salt for ease of handling but may be converted into the free amine form by neutralization with base.

Elemental Analysis of Polyethylenimine "Max" 4,000 Mw

(Equivalent to Mw ~2,500 in free base form)

	%C	%H	%N	%Cl	Total
Theoretical †	28.6	7.8	16.7	42.2	95.30
Found	28.99	7.47	16.52	42.06	95.042

†*based on 5.4% water content*

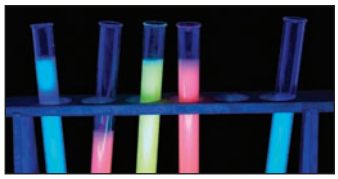
Description		Mol. Wt.	Cat. #	Size
New Polyethylenimine *"Max"*	*~2,500 *(in free base form)*		24885	2g
	**25,000 *(in free base form)*		24765	2g
Polyethylenimine, Linear		2,500	24313	2g
		25,000	23966	2g
		250,000	24314	2g

Our high potency Polyethylenimine "Max" is supplied as a hydrochloride salt for ease of handling.

**Nominally 4,000 Mw in hydrochloride salt form (calculated value).*
***Nominally 40,000 Mw in hydrochloride salt form.*

Labeling of Polymers

cont. from 3



Water Soluble Fluorescing Polymers

The incorporation of FITC (fluorescein isothiocyanate) with t-butyl acrylate monomer and an amino monomer, designated as M-2, creates a water soluble fluorescing polymer. The high luminescence of this polymer in water allows for detection when bioconjugated with target biomolecules and cells.

(S. Fu et. al. J. Macromolecular Science, Part A-Pure and Applied Chemistry, Vol. A41, No. 4, pg 357, 2004)

Fluorescent Polymeric Microparticles

Among the advantages of the polymeric microparticles is their ability to accommodate different wavelength emitters, producing many distinct channels for detection. Polysciences, Inc. offers a wide range of fluorescent microspheres useful for many applications.

- Diagnostic systems including lateral flow assay kits
- Cell tracing by conjugate labeling
- Fluorescent labels for conjugation with proteins
- Flow cytometry
- Tracing water flow
- Attachment to bioactive molecules and removal magnetically
- Inclusion in product to identify the point of manufacture

Polysciences, Inc. offers a wide range of standard products as well as custom synthesis of labeled polymers for specialized applications, please contact us or visit www.polysciences.com for more details.

Polysciences, Inc. 400 Valley Road, Warrington, PA 18976 **Phone:** 1 (800) 523-2575 / (215) 343-6484 **Fax:** (800) 343-3291 / (215) 343-0214 **email:** info@polysciences.com
Polysciences Europe GmbH Handelsstr. 3 D-69214 Eppelheim, Germany **Phone:** (49) 6221-765767 **Fax:** (49) 6221-764620 **email:** info@polysciences.de