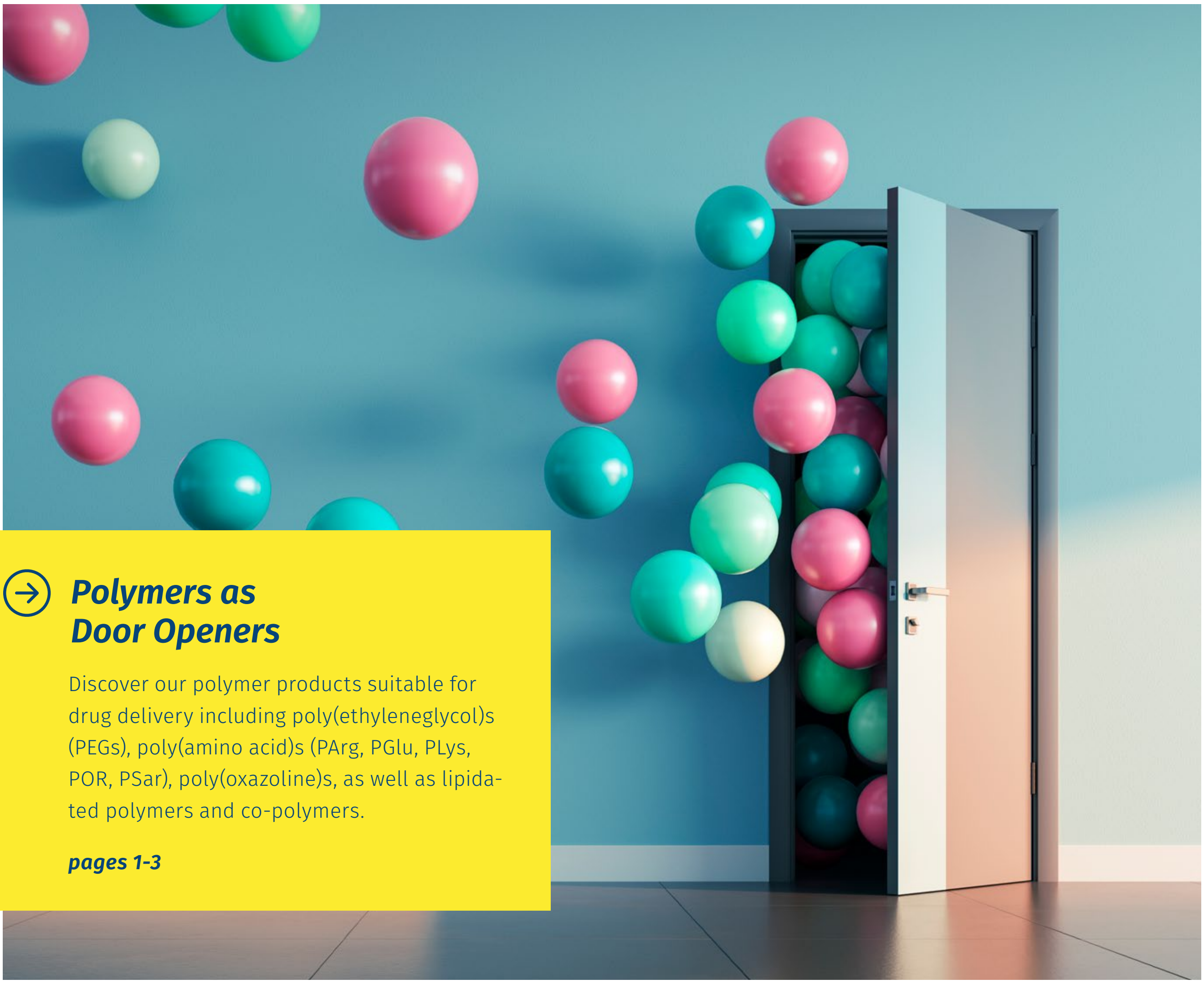
Iris Biotech

POLYMER THERAPEUTICS

for Drug Delivery



Polymers as Door Openers

Discover our polymer products suitable for drug delivery including poly(ethyleneglycol)s (PEGs), poly(amino acid)s (PArg, PGlu, PLys, POR, PSar), poly(oxazoline)s, as well as lipidated polymers and co-polymers.

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Poly(ethylene glycol)s - oldies but goldies.

page 1

Innovative (co)polymers based on poly(amino acid)s and poly(oxazoline)s.

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Benefit of our services - let us be your partner!

page 4

Version: IF20_3

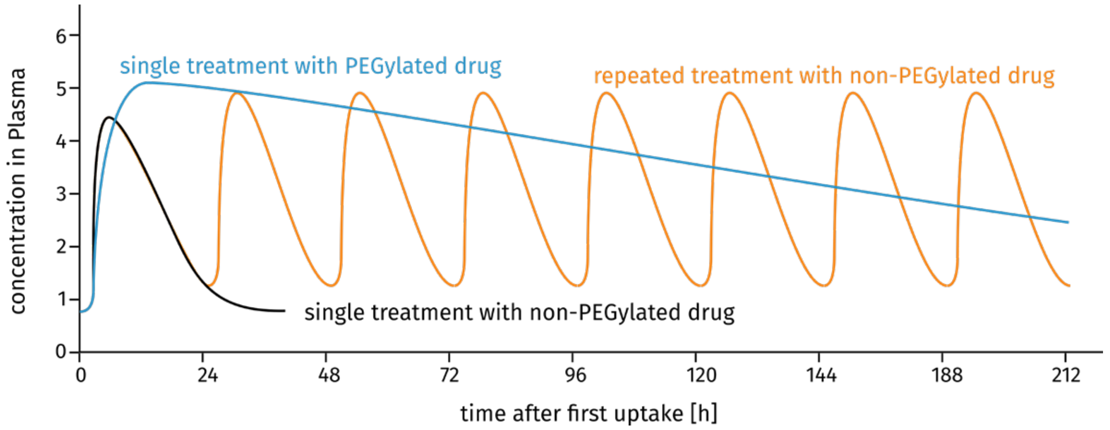
Polymer Therapeutics

for Drug Delivery

Poly(ethylene glycol)s

Small drug molecules like peptides and other biomolecules have high potential as drugs due to their specificity and efficacy in combination with low side effects. However, they suffer from rapid clearance from the human body and show poor pharmacokinetic properties which limits their applications. Due to the fact that such biomolecules are similar to biological components, they are easily attacked by the immune system of the body, i.e. by antibodies and degradation enzymes. Another limitation might be insufficient solubility. Thus, many promising novel drug molecules will never reach market approval.

Attaching polymers which are tolerated by the physiologic systems, such as poly(amino acids), poly(ethylene glycol)s or other variants improves drastically their bioavailability and biodistribution and turns sensitive biomolecules into robust drugs. First attempts with polymers were made already in the 1960s – either by attaching the therapeutic agent covalently to a polymer or by entrapping it non-covalently in a polymer nanoparticle. Over the years, polymers have garnered attention in the evolution of drug delivery technologies for both water-soluble and hydrophobic drug molecules.



Pharmacokinetic properties of a PEGylated drug in comparison with a non-PEGylated drug.

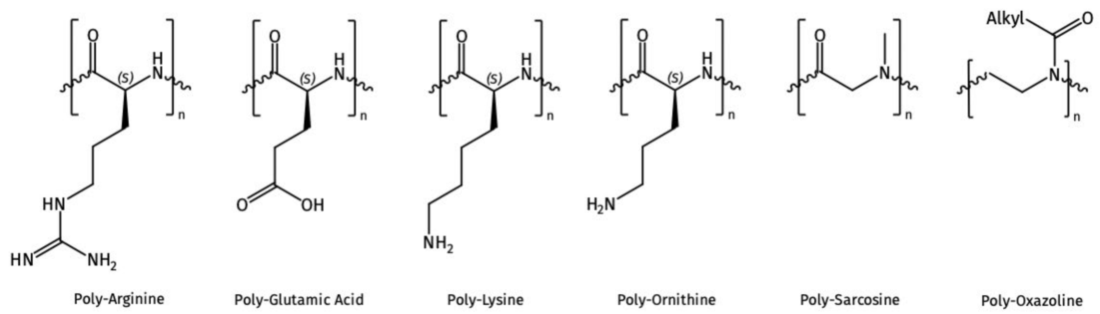
The first polymer-drug conjugates that showed promising results contained poly(ethyleneglycol) (PEG). The pharmacological effects of PEG and many other first generation polymer attachments are mainly of physical nature. They act solubilizing due to their hydrophilicity, prevent degradation, and reduce immunogenicity by shielding the pharmaceutical and prevent excretion by increasing the hydrodynamic radius.

Iris Biotech offers a portfolio of a thousand different PEG chemicals with a length ranging from only two ethylenglycol units (with a molecular weight around 100 g/mol) up to long chain PEGs of molecular weights beyond 20,000 g/mol. Further to this standard portfolio, we can produce for you also customized PEG variants according to your personal needs.

Poly(amino acid)s

Eventhough PEGs still represent the most frequently used polymer for drug delivery, several possible side effects and complications are reported for this type of polymer, e.g. non-biodegradability/accumulation and immunogenicity. Besides, growing knowledge on drug delivery technologies allows to create “intelligent” systems which can help transporting a payload to a target destination or even to destinations where it could not go without the polymer’s help. Biodegradable poly(amino acid)s appear very attractive in this context. However, their availability in sufficient quality and quantity for broad pharmaceutical application was a bottleneck in the first years.

At Iris Biotech, we are presenting biodegradable and biocompatible poly(amino acid)s (PArg, PGlu, PLys, POr, PSar) as well as poly(oxyzolines) as polymers for drug delivery.

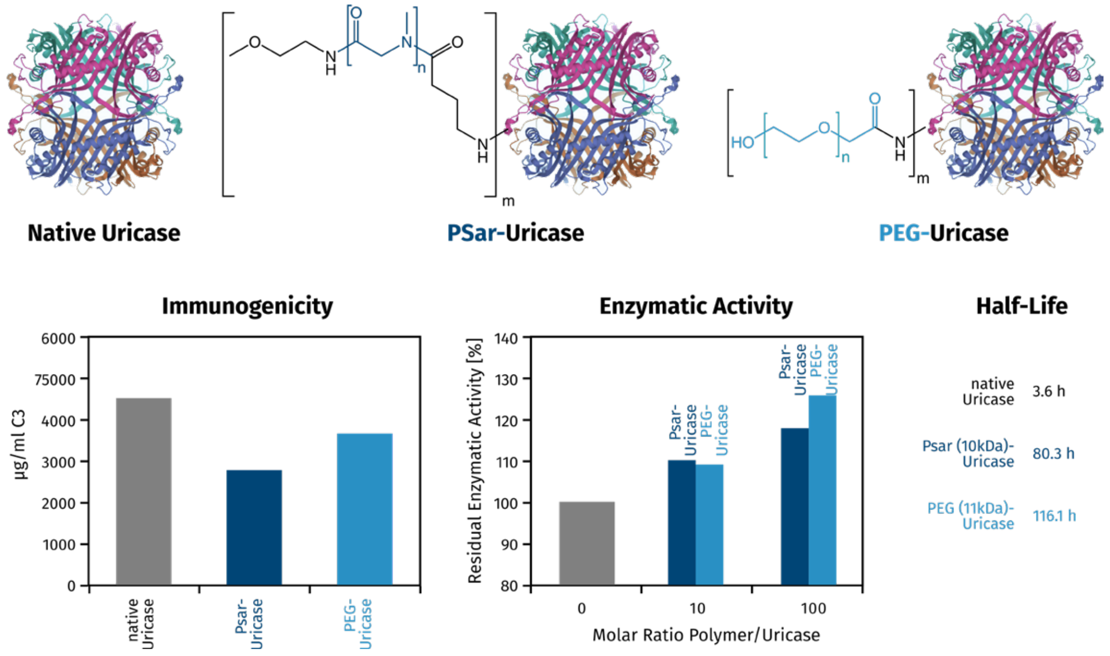


General chemical structures of poly(amino acid)s and POx available at Iris Biotech.

Poly(sarcosines) have been employed in a number of drug delivery systems and are gaining increasing attention. Iris Biotech offers monofunctional, homo- and heterobifunctional poly(sarcosines) with a wide variety of functional groups. Degrees of polymerization (n) may range from below 10 to above 1,000. Thus, molar masses of approx. 1 kg/mol to 100 kg/mol are feasible.

The use of poly(sarcosines) with functional head- and tail-groups for bioconjugation is comparable to the well-known PEGylation technology. In a study, a poly(sarcosine)- and PEG-conjugated Uricase were compared, and it was shown that the PSar conjugation is efficient in extending Uricase half-life *in vivo* more than 20-fold. Furthermore, PSar-Uricase is less immunogenic compared to either native or PEGylated Uricase *in vivo*, and polysarcosination did not affect the enzymatic activity.

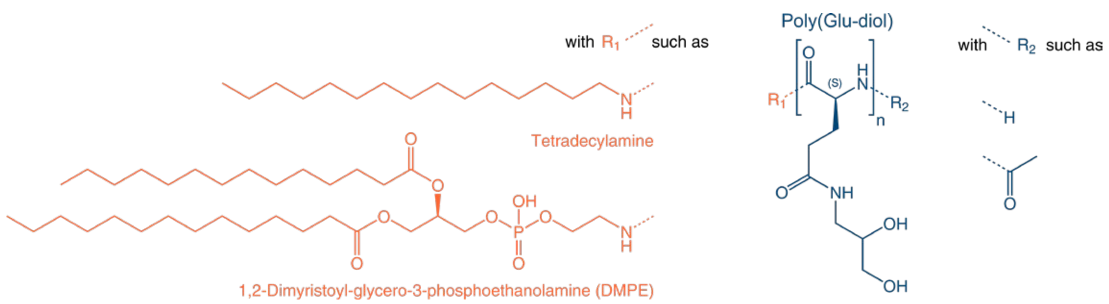
Polymer-Lipid Conjugates



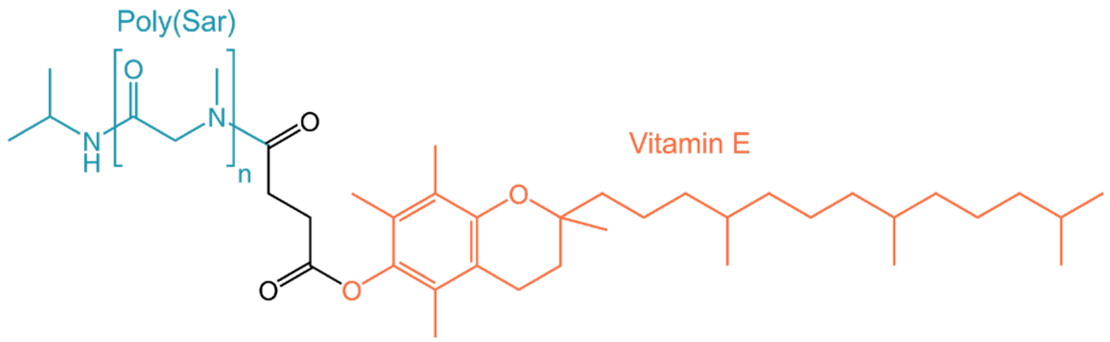
Case Study Uricase: PEGylation vs. Polysarcosination.

Almost all polymers discussed by now are water soluble – for good reason: most drug delivery systems are designed to transport their payload in the bloodstream and thus they must be highly water soluble. However, once the delivery complex has reached its destination, the picture turns to the opposite: if a cargo should enter a cell through the cell membrane (which mainly consists of a hydrophobic lipid bilayer), a highly hydrophilic transport system is rather counterproductive. Here, a lipophilic moiety should rather be helpful. Therefore, many drug delivery systems also contain hydrophobic blocks that help to form barrier-overbearing nanostructures such as micelles, liposomes, or lipid nanoparticles (LNPs).

Especially in the curse of the worldwide Corona pandemic, the development of mRNA vaccines emphasized the importance of tools for secured RNA delivery as they themselves are unable to cross physiological barriers and are susceptible to enzymatic degradation by endogenous nucleases. Thus, for successful RNA drug delivery, polymer-conjugated lipid nanoparticles (LNPs) capable to permeate plasma membranes are reported in literature.



PGA Lipid combinations available at Iris Biotech. For more information, see related products.



PSar Lipid combinations available at Iris Biotech. For more information, see related products.

Copolymers

Another attractive feature of the polymers presented is the fact that they can be combined with each other to form different types of copolymers, e.g. grafted polymers, random copolymers or block copolymers. This allows us to modify parameters such as size, conformation, charge, solubility, geometry, and topoplogy and opens a toolbox to an almost unlimited number of combinations specifically tailored to your particular needs.

Services

Benefit of our services! Formulation of multiple bench-scale samples from 1-5 ml and scaling up from 0,2-5 l are available. Formulation services are mainly focused on the support of client-based screening assays and scale up. These services include optimization of key process parameters such as molar ratios, mixing flow rates, concentration, and flow speed.

Our scientists support the development of polymer therapeutic substances and their analysis through the entire project life cycle from first R&D batches through pre-clinical material to final GMP- & GLP-certified commercial production and testing. Equipment and skills are specially suited but not limited to method development, validation, and stability studies.

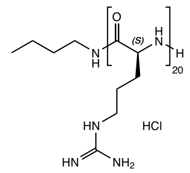
Poly-Arginines

Product details

PAR1060 *n*Bu-PArg(20)*HCl

n-Butyl-poly-L-Arginine hydrochloride

CAS-No.	26982-20-7
Mol. weight	3800 Da

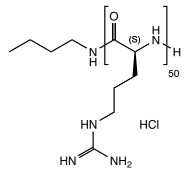


Product details

PAR1020 *n*Bu-PArg(50)*HCl

n-Butyl-poly-L-Arginine hydrochloride

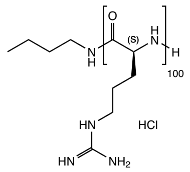
CAS-No. 26982-20-7
Mol. weight 9600 Da



PAR1030 *n*Bu-PArg(100)*HCl

n-Butyl-poly-L-Arginine hydrochloride

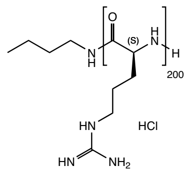
CAS-No. 26982-20-7
Mol. weight 19000 Da



PAR1050 *n*Bu-PArg(200)*HCl

n-Butyl-poly-L-Arginine hydrochloride

CAS-No. 26982-20-7
Mol. weight 38500 Da



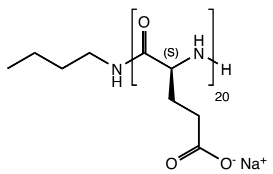
Poly-Glutamic Acids

Product details

PGA1005 *n*Bu-PGA(20)

n-Butyl-poly(L-glutamic acid) sodium salt

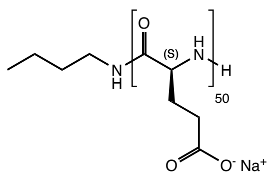
CAS-No. 26247-79-0
Mol. weight 3000 Da



PGA1010 *n*Bu-PGA(50)

n-Butyl-poly(L-glutamic acid) sodium salt

CAS-No. 26247-79-0
Mol. weight 7500 Da

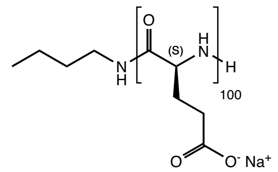


Product details

PGA1015 *n*Bu-PGA(100)

n-Butyl-poly(L-glutamic acid) sodium salt

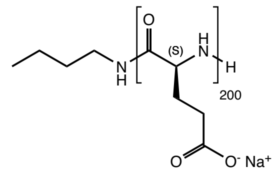
CAS-No. 26247-79-0
Mol. weight 15100 Da



PGA1020 *n*Bu-PGA(200)

n-Butyl-poly(L-glutamic acid) sodium salt

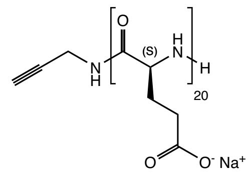
CAS-No. 26247-79-0
Mol. weight 30200 Da



PGA1085 Prg-PGA(20)

Propargyl-poly(L-glutamic acid) sodium salt

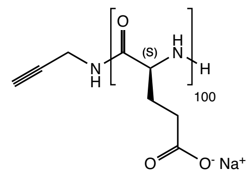
Mol. weight 3000 Da



PGA1095 Prg-PGA(100)

Propargyl-poly(L-glutamic acid) sodium salt

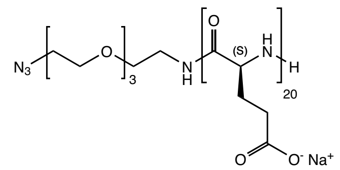
Mol. weight 15000 Da



PGA1125 N_3-PGA(20)

Azido-ethyltri(ethylene glycol)-poly(L-glutamic acid) sodium salt

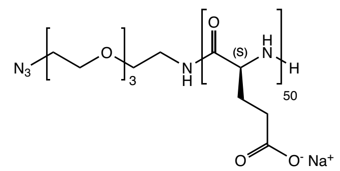
Mol. weight 3000 Da



PGA1130 N_3-PGA(50)

Azido-ethyltri(ethylene glycol)-poly(L-glutamic acid) sodium salt

Mol. weight 7500 Da

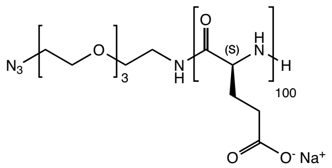


Product details

PGA1135 N_3-PGA(100)

Azido-ethyltri(ethylene glycol)-poly(L-glutamic acid) sodium salt

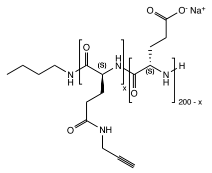
Mol. weight 15000 Da



PGA1205 *n*Bu-PGA(200)[Prg(20)]

n-Butyl-poly(L-glutamic acid gamma-propargyl amide) sodium salt (10-20mol% propargyl substitution)

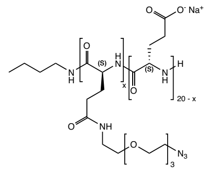
Mol. weight 30000 Da



PGA1290 *n*Bu-PGA(20)[PEG2-N_3(10% mod)]

n-Butyl-poly(L-glutamic acid gamma-azido-ethyltri(ethylene glycol) amide) sodium salt (10-20mol% azido substitution)

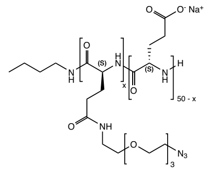
Mol. weight 3600 Da



PGA1295 *n*Bu-PGA(50)[PEG2-N_3(10% mod)]

n-Butyl-poly(L-glutamic acid gamma-azido-ethyltri(ethylene glycol) amide) sodium salt (10-20mol% azido substitution)

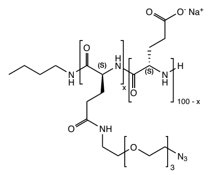
Mol. weight 9100 Da



PGA1300 *n*Bu-PGA(100)[PEG2-N_3(10% mod)]

n-Butyl-poly(L-glutamic acid gamma-azido-ethyltri(ethylene glycol) amide) sodium salt (10-20mol% azido substitution)

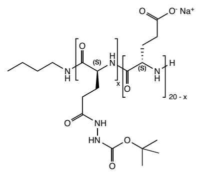
Mol. weight 18300 Da



PGA1810 *n*Bu-PGA(20)[Hyd(10% mod)]

n-Butyl-poly(L-glutamic acid gamma-*t*-butyl carbazate) sodium salt (10-20mol% substitution)

Mol. weight 3700 Da

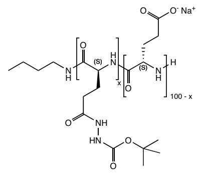


Product details

PGA1770 *n*Bu-PGA(100)[Hyd(10% mod)]

n-Butyl-poly(L-glutamic acid gamma-*t*-butyl carbazate) sodium salt (10-20 mol% substitution, MW 20200Da)

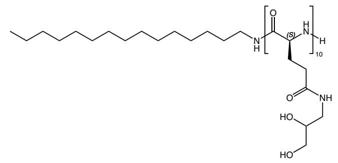
Mol. weight 20200 Da



PGA1880 C14-[PGA(DIOL)]$_{10}$-H

(Tetradecylamine)-poly-L-glutamic acid(gamma-dihydroxypropylamide)acetamide

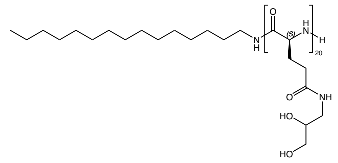
Mol. weight 2000 Da



PGA1890 C14-[PGA(DIOL)]$_{20}$-H

(Tetradecylamine)-poly-L-glutamic acid(gamma-dihydroxypropylamide)acetamide

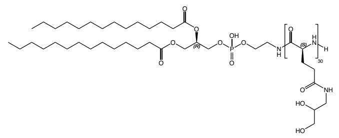
Mol. weight 4000 Da



PGA1920 DMPE-[PGA(DIOL)]$_{30}$-H

(1,2-Dimyristoyl-glycero-3-phosphoethanolamine)-poly-L-glutamic acid(gamma-dihydroxypropylamide) acetamide

Mol. weight 7000 Da



Poly-Lysines

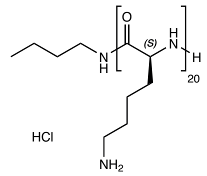
Product details

PLY1030 *n*Bu-PLys(20)*HCl

n-Butyl-poly-L-Lysine hydrochloride

CAS-No. 26124-78-7

Mol. weight 3300 Da

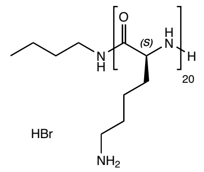


Product details

PLY1031 *n*Bu-PLys(20)*HBr

n-Butyl-poly-L-Lysine hydrobromide

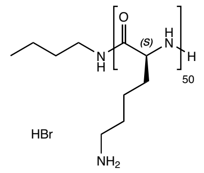
CAS-No. 26124-78-7
Mol. weight 4200 Da



PLY1001 *n*Bu-PLys(50)*HBr

n-Butyl-poly-L-Lysine hydrobromide

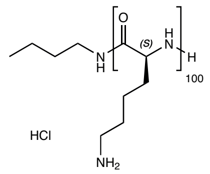
CAS-No. 26124-78-7
Mol. weight 10500 Da



PLY1010 *n*Bu-PLys(100)*HCl

n-Butyl-poly-L-Lysine hydrochloride

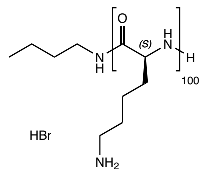
CAS-No. 26124-78-7
Mol. weight 16000 Da



PLY1011 *n*Bu-PLys(100)*HBr

n-Butyl-poly-L-Lysine hydrobromide

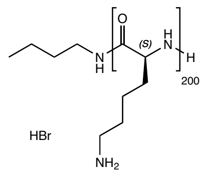
CAS-No. 26124-78-7
Mol. weight 20900 Da



PLY1021 *n*Bu-PLys(200)*HBr

n-Butyl-poly-L-Lysine hydrobromide

CAS-No. 26124-78-7
Mol. weight 42000 Da



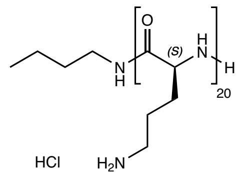
Poly-Ornithines

Product details

POR1060 *n*Bu-POR(20)*HCl

n-Butyl-poly-L-Ornithine hydrochloride

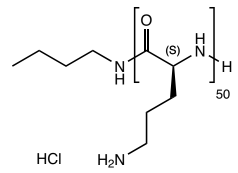
CAS-No. 26982-21-8
Mol. weight 3000 Da



POR1020 *n*Bu-POR(50)*HCl

n-Butyl-poly-L-Ornithine hydrochloride

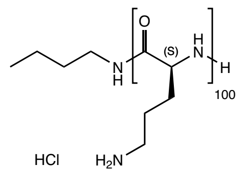
CAS-No. 26982-21-8
Mol. weight 5800 Da



POR1030 *n*Bu-POR(100)*HCl

n-Butyl-poly-L-Ornithine hydrochloride

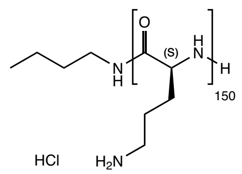
CAS-No. 26982-21-8
Mol. weight 15000 Da



POR1040 *n*Bu-POR(150)*HCl

n-Butyl-poly-L-Ornithine hydrochloride

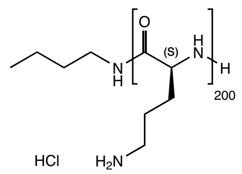
CAS-No. 26982-21-8
Mol. weight 22600 Da



POR1050 *n*Bu-POR(200)*HCl

n-Butyl-poly-L-Ornithine hydrochloride

CAS-No. 26982-21-8
Mol. weight 30100 Da

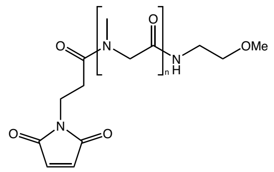


Poly-Sarcosines

Product details

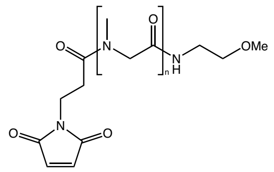
PSR1740 Mal-PSar-OMe (5 kDa)

N-alpha-(3-maleimido)-propanamide polysarcosine omega-methoxyethylamide



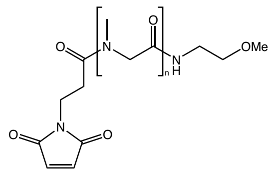
PSR1750 Mal-PSar-OMe (10 kDa)

N-alpha-(3-maleimido)-propanamide polysarcosine omega-methoxyethylamide



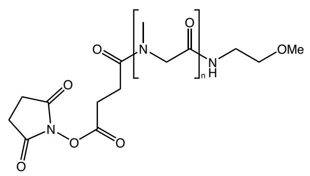
PSR1760 Mal-PSar-OMe (15 kDa)

N-alpha-(3-maleimido)-propanamide polysarcosine omega-methoxyethylamide



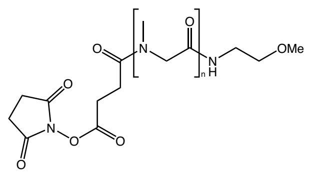
PSR1770 NHS-PSar-OMe (5 kDa)

N-alpha-(succinimidylester)-polysarcosine omega-methoxyethylamide



PSR1780 NHS-PSar-OMe (10 kDa)

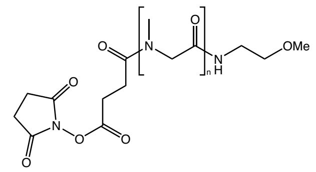
N-alpha-(succinimidylester)-polysarcosine omega-methoxyethylamide



Product details

PSR1790 NHS-PSar-OMe (15 kDa)

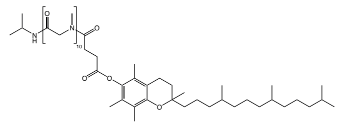
N-alpha-(succinimidylester)-polysarcosine omega-methoxyethylamide



PSR1830 VitE-PSar$_{10}$

N-alpha-isopropyl polysarcosine(10) N-omega-(Vitamine E)-4-oxobutanoate

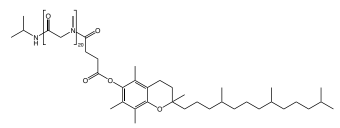
Mol. weight 1300 Da



PSR1820 VitE-PSar$_{20}$

N-alpha-isopropyl polysarcosine(20) N-omega-(Vitamine E)-4-oxobutanoate

Mol. weight 2000 Da



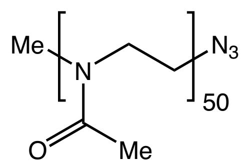
Poly-Oxazolines

Product details

POX1200 Me-PMeOx(50)-N$_3$

alpha-Methyl-poly(2-methyl-2-oxazoline)-omega-azide

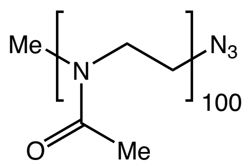
CAS-No.	26375-28-0
Formula	$CH_3(C_4H_7NO)50N_3$
Mol. weight	4300 Da



POX1210 Me-PMeOx(100)-N$_3$

alpha-Methyl-poly(2-methyl-2-oxazoline)-omega-azide

CAS-No.	26375-28-0
Formula	$CH_3(C_4H_7NO)100N_3$
Mol. weight	8500 Da

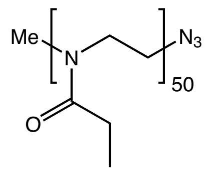


Product details

POX2200 Me-PEtOx(50)-N_3

alpha-Methyl-poly(2-ethyl-2-oxazoline)-omega-azide

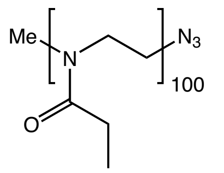
CAS-No. 25805-17-8
Formula $CH_3(C_5H_9NO)50N_3$
Mol. weight 5000 Da



POX2210 Me-PEtOx(100)-N_3

alpha-Methyl-poly(2-ethyl-2-oxazoline)-omega-azide

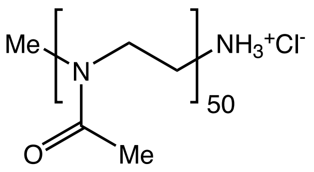
CAS-No. 25805-17-8
Formula $CH_3(C_5H_9NO)100N_3$
Mol. weight 5000 Da



POX1220 Me-PMeOx(50)-NH_2*HCl

alpha-Methyl-poly(2-methyl-2-oxazoline)-omega-amine hydrochloride

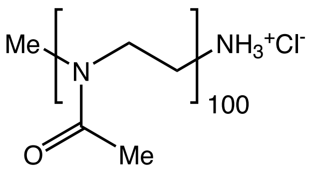
CAS-No. 26375-28-0
Formula $CH_3(C_4H_7NO)50NH_2$*HCl
Mol. weight 4300 Da



POX1230 Me-PMeOx(100)-NH_2*HCl

alpha-Methyl-poly(2-methyl-2-oxazoline)-omega-amine hydrochloride

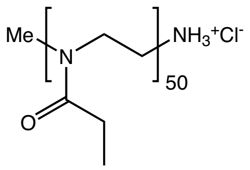
CAS-No. 26375-28-0
Formula $CH_3(C_4H_7NO)100NH_2$*HCl
Mol. weight 8500 Da



POX2220 Me-PEtOx(50)-NH_2*HCl

alpha-Methyl-poly(2-ethyl-2-oxazoline)-omega-amine hydrochloride

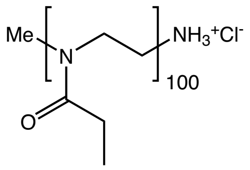
CAS-No. 25805-17-8
Formula $CH_3(C_5H_9NO)50NH_2$*HCl
Mol. weight 5000 Da



POX2230 Me-PEtOx(100)-NH_2*HCl

alpha-Methyl-poly(2-ethyl-2-oxazoline)-omega-amine hydrochloride

CAS-No. 25805-17-8
Formula $CH_3(C_5H_9NO)100NH_2$*HCl
Mol. weight 10000 Da

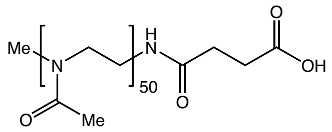


Product details

POX1240 Me-PMeOx(50)-COOH

alpha-Methyl-poly(2-methyl-2-oxazoline)-omega-succinamic acid

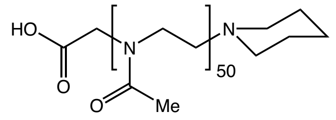
CAS-No. 26375-28-0
Formula $CH_3(C_4H_7NO)50COCH_2CH_2COOH$
Mol. weight 4300 Da



POX1241 HOOC-PMeOx(50)-Pip

alpha-Carboxymethyl-poly(2-methyl-2-oxazoline)-omega-Piperidine

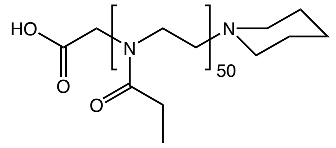
Formula $HOOCCH_2(C_4H_7NO)50NC_6H_{12}$
Mol. weight 4300 Da



POX2241 HOOC-PEtOx(50)-Pip

alpha-Carboxymethyl-poly(2-ethyl-2-oxazoline)-omega-piperidine

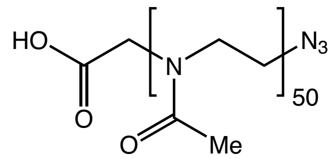
Formula $HOOC\text{-}CH_2(C_5H_9NO)50NC_6H_{12}$
Mol. weight 5000 Da



POX1250 HOOC-PMeOx(50)-N_3

alpha-Carboxymethyl-poly(2-methyl-2-oxazoline)-omega-azide

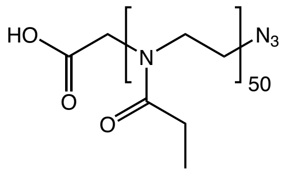
CAS-No. 26375-28-0
Formula $HOCOCH_2(C_4H_7NO)50N_3$
Mol. weight 4300 Da



POX2250 HOOC-PEtOx(50)-N_3

alpha-Carboxymethyl-poly(2-ethyl-2-oxazoline)-omega-azide

CAS-No. 25805-17-8
Formula $HOCOCH_2(C_5H_9NO)50N_3$
Mol. weight 5000 Da



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