VORNIA BIOMATERIALS

# Certificate of Analysis for HB-PEG-MAP-A

**PRODUCT CODE:** HB-PEG-MAP-A010 **LOT NUMBER:** HBPEGMAPA01/16

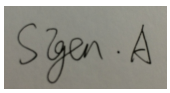
**EXPIRY DATE:** 06/2017

## Quality Control Analysis

| Characteristic | Specification | Result |
|---|---|---|
| Molecular weight (from GPC) | 20-25 kDa | 23 kDa |
| PDI | 2.0 | 1.9 |
| Branching degree (%) | 40-60% | 46.5% |
| Vinyl content [mmol/g] | 0.6-1.2 mmol/g | 0.8 mmol/g |
| Purity [%] | >95% | 98% |
| pH after rehydration in PBS | Neutral (6.5-7.5) | 7.4 |
| Appearance | colourless/pale yellow viscous liquid | Pale yellow viscous liquid |
| Water solubilisation time [min] | Should dissolve within 1 minutes | 1 min under vortex |

**NOTE:** This product is packaged in 10 mL brown glass vials under argon. Do not expose to air until use as crosslinking will begin spontaneously.

**Name: Sigen A**

**Signature:** 

**Date: 16.08.2016**

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## Instructions for Use

# Vornia Hyperbranched PEG-based Multi Acrylate Polymer type A (HB-PEG-MAP-A)

### Overview

Vornia Hyperbranched PEG-based Multi Acrylate Polymer type A (HB-PEG-MAP-A) is synthesized using PEGDA of different chain length as the monomers. Molecular weight, branching degree and vinyl group content of the polymers can be easily adjusted. HB-PEG-MAP-A possesses good biocompatibility as well as fast gelation time with thiolated nature polymer (HA-SH/Gel-SH) which make this type of polymers very promising materials for biological applications. It may be used in conjunction with ECM proteins such as collagen, laminin, or fibronectin for most 3D cell culture and tissue-engineering applications.

The synthetic pathway was developed in collaboration with leading scientists in University College Dublin, Ireland, in response to customer requests for hyperbranched polymer suitable for tissue engineering applications, especially for the production of hydrogels in the investigation of wound healing. Vornia's HB-PEG-MAP-A possesses high amount of acrylate groups in the terminal chain of the polymer structure which make the gelation time of this type of polymer very short with multi-vinyl cross-linkers (<30 min) or exposed to UV light (<5 min). All batches of HB-PEG-MAP-A are provided with full certificate of analysis.

### Product Description

Vornia HB-PEG-MAP-A is supplied as a viscous liquid. It is provided at a mass of 1 g in 10 mL brown vials with rubber insert caps for convenient re-constitution with minimal exposure to air. Our HB-PEG-MAP-A is packaged under inert argon gas.

### Storage Instructions

Vornia HB-PEG-MAP-A should be stored in its original vial at 2-8 °C and used within one year of its production date.

Our HB-PEG-MAP-A product is provided non-sterile, therefore, for aseptic applications we recommend passing reconstituted Hyaluronic Acid through a 0.22 µm filter prior to use.

### Instructions for Use

HB-PEG-MAP-A will crosslink in the presence of oxygen or being exposed to light. Therefore, it should be re-constituted in degassed, deionized water (sterile, if using in cell culture). Our vial caps are designed to allow for the insertion of a needle through the rubber insert for the purposes of re-constitution without opening the vial and exposing the product to oxygen in the air.

I. To relieve pressure inside the vial, pierce the rubber insert with a fine-tipped needle and, using a syringe, extract a 15 mL volume of the inert gas which blankets the product.
II. Resuspend in 10 mL of degassed 1X PBS, using a needle and syringe, to achieve a stock concentration of 100 mg/mL (observe aseptic technique if intended for cell culture).
III. To dissolve, we recommend unopened vials to be set to shake at 600 rpm, or greater, (or vortex) for <10 min (pH needs to be adjusted to neutral after fully dissolution).
IV. For gelation of Vornia HB-PEG-MAP-A, we recommend the addition of crosslinking multivinyl polymer (e.g. PEGDA) in 1:4 ratio and incubation at 37°C. Gelation occurs between 10 min to 30 min, depending on % w/v of crosslinker.

# Vornia Bio-inks:

**Note：**

Vornia Bio. Ltd. supplies two kinds of hyperbranched PEG-based multi acrylate polymers (HB-PEG-MAP): ***HB-PEG-MAP-A*** **(10K HB-PEG-MAP-A with more than 10 arms and 20K HB-PEG-MAP-A with more than 20 arms) for fabricating chemical crosslinked hydrogels (in combination with Vornia's thiolated nature-derived biopolymers)** and ***HB-PEG-MAP-B*** **(10K HB-PEG-MAP-B with more than 10 arms and 20K HB-PEG-MAP-B with more than 20 arms)** for UV fast curing hydrogels. Both of the two gelation systems possess good biocompatibility, excellent mechanical properties as well as fast and tunable gelation time (seconds to minutes) which make our polymers very promising materials for 3D-bioprinting.

Moreover, the molecular weight, branching degree and acrylate content of the polymers can be easily adjusted to meet the diversified demands of customers and co-operators.

Vornia Bio. Ltd. also supplies different types of nature-derived biopolymers:

High Mw thiolated hyaluronic acid (***HA-SH-High Mw***)

Low Mw thiolated hyaluronic acid (***HA-SH-Low Mw***)

Thiolated Gelatin type B (***Gel-SH***)

Methacrylated hyaluronic acid (***HA-MA***)

The substitution degree of functional group can be adjusted which can regulate the crosslinking degree, gelation time and stiffness of the hydrogel.

## Soft Type Materials:

### Gelation systems:

1. Chemical Cross linking Hydrogel System:

| Gelation system | Component | Final Concentration | Properties |
|---|---|---|---|
| A | HB-PMAP-A | 5-15% | Fast gelling, good cell compatibility |
| | HA-SH (high and low Mw) | 0.5-1% | |
| B | HB-PMAP-A | 5-15% | Fast gelling, good cell compatibility and cell adhesion |
| | Gelatin-SH (type B) | 5-10% | |

2. UV Curable Hydrogel System:

| Gelation system | Component | Final Concentration | Properties |
|---|---|---|---|
| C | HB-PMAP-B | 10-15% | Fast gelling, excellent mechanical performance |
| | Initiator (2959) | 0.1%-1% (w/w) | |
| D | HA-methacrylate | 5-10% | Fast gelling, excellent mechanical performance |
| | Initiator (2959) | 0.1%-1% (w/w) | |

**Nature-derived biopolymers:**

1. **Thiolated HA**

| Materials | Degree of substitution (%) | Free thiol fraction (%) | Free thiol content |
|---|---|---|---|
| HA-SH-High Mw | 50-60% | 50-60% | 1.0-1.2 mmol/g |
| HA-SH-Low Mw | 60-80% | 60-80% | 1.2-1.6 mmol/g |

2. **Thiolated Gelatin**

| Materials | Degree of substitution (%) | Free thiol content |
|---|---|---|
| Gelatin-SH (type B) | 50-57% | 0.57 mmol/g |

3. **Thiolated Gelatin**

| Materials | Degree of substitution (%) | Free MA content |
|---|---|---|
| HA-MA | 40% | 0.92 mmol/g |