POLY(GLYCERYL GLYCEROL)

A Building Block for Multi-Functional Biomaterials

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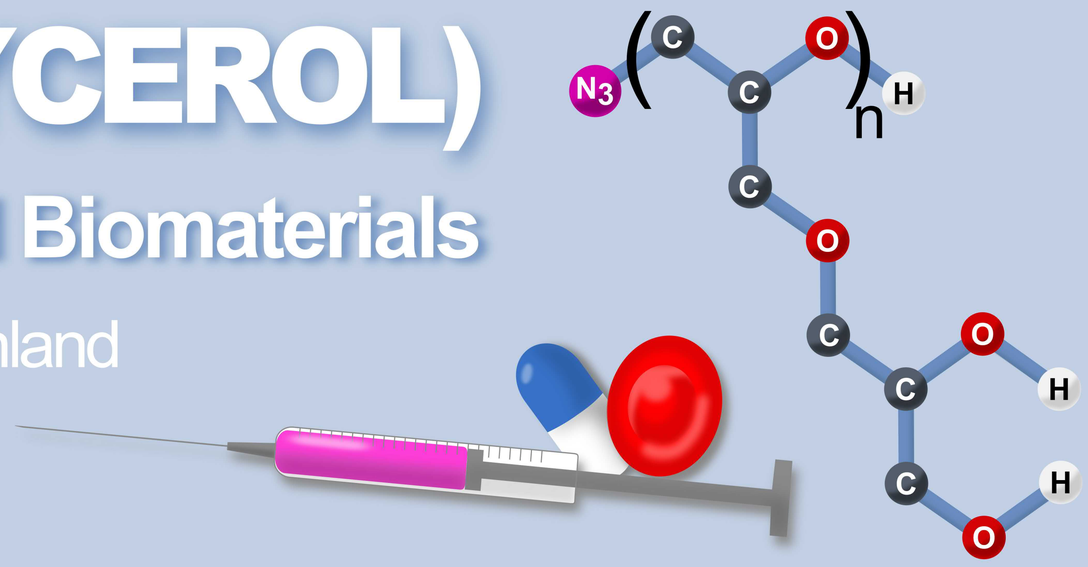
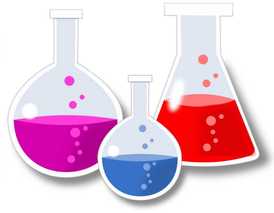
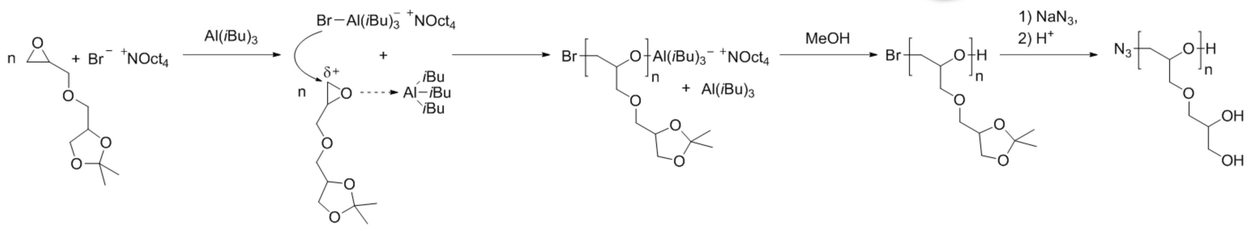
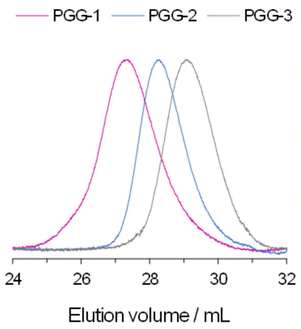


Synthesis

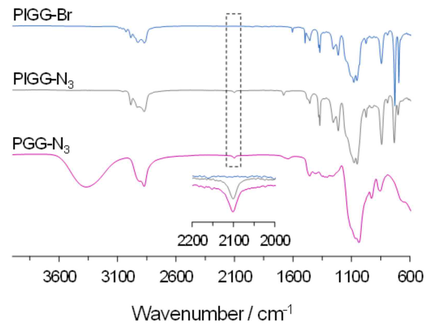






Code	$DP_{theor.}$	$M_{n,theor.}$ / g mol^{-1}	$M_{n,SEC}$ / g mol^{-1}	PDI_{SEC}
PIGG-1	67	12 600	13 900	1.60
PGG-1	67	9 900	9 200	1.45
PIGG-2	67	12 600	11 100	1.13
PGG-2	67	9 900	5 800	1.21
PIGG-3	51	9 600	9 100	1.36
PGG-3	51	7 600	3 500	1.25

SEC of PIGGs in THF with PS standards; SEC of PGGs in 0.1 M $NaNO_3$ with PEO standards.



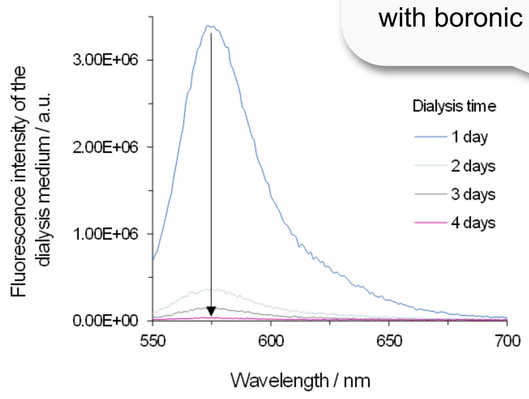
Poly(glyceryl glycerol) (PGG) is prepared by monomer-activated ring-opening polymerization with a functional initiator and subsequent acidic deprotection. Initiation with tetrabutylammonium azide yields azide-functional polymers directly, but larger counter ions, as in tetraoctylammonium bromide, enhance the polymerization rate and give narrower molecular weight distributions.
Azide-functional PGG is readily coupled to polymers and biomolecules via "click" reaction. The 1,2-diol groups in every PGG repeating unit can be functionalized with a multitude of probes, drugs and targeting ligands.

Labeling

Post-assembly functionalization of PGG-decorated polymer particles is accomplished by simple mixing with boronic acids. The 1,2-diol groups in every PGG repeating unit form boronic esters in neutral aqueous conditions with 86 % labeling efficiency (LE).
In contrast, a comparable dye without boronic acid moiety is completely removed during purification by dialysis (LE < 1 %).

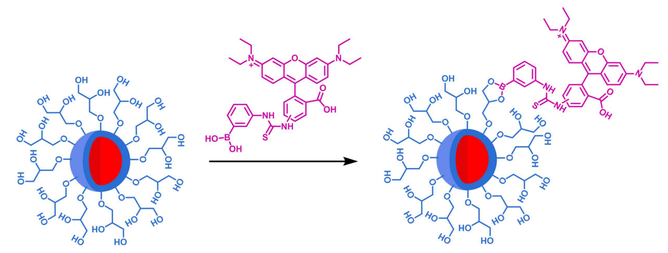
PGG-PLA | PGG-PLA + rhodamine B boronic acid | PGG-PLA + rhodamine B

"Mix & stick" post-functionalization with boronic acids

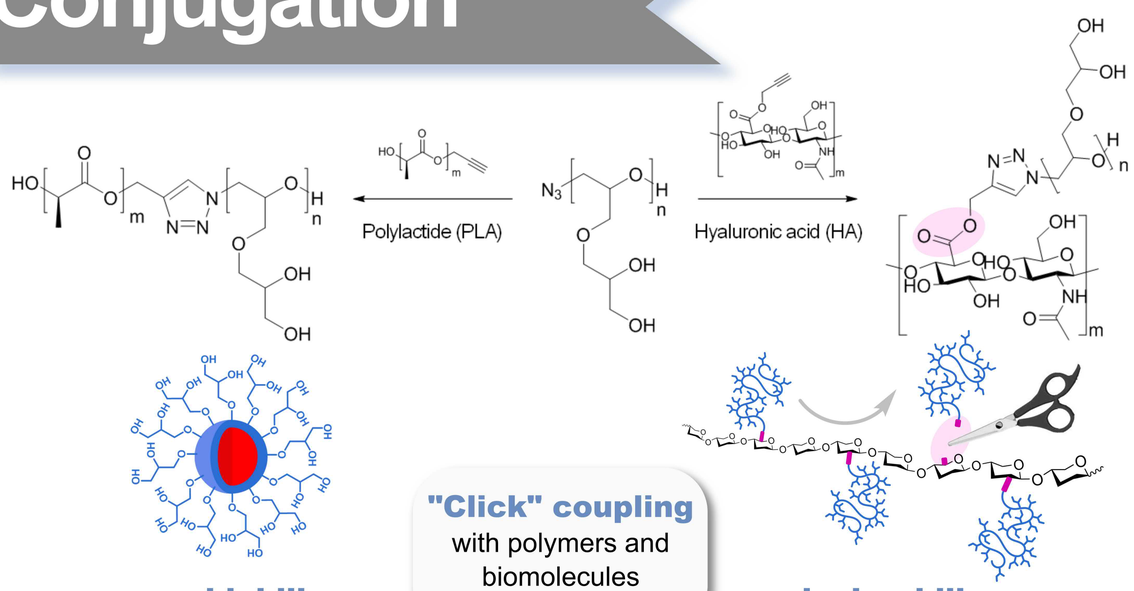


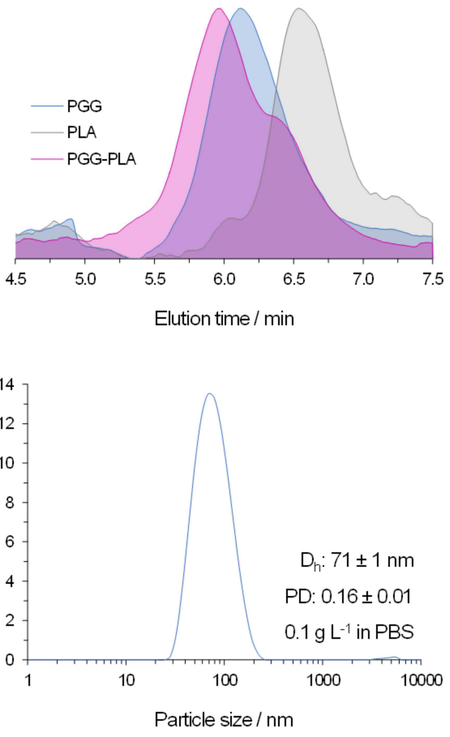
Type of dye	Amount added	Dye content after dialysis	Labeling efficiency
Rhodamine B boronic acid	28.7 · 10^{-5} M	24.6 · 10^{-5} M	85.5 %
Rhodamine B	28.7 · 10^{-5} M	0.06 · 10^{-5} M	0.2 %

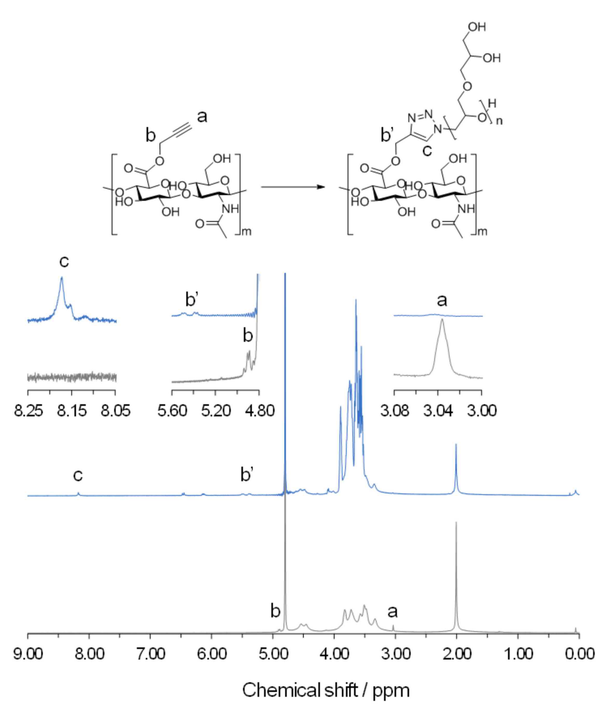
Dye concentration in a 1 g L^{-1} dispersion of PGG-PLA particles in PBS determined by fluorescence spectroscopy.



Conjugation

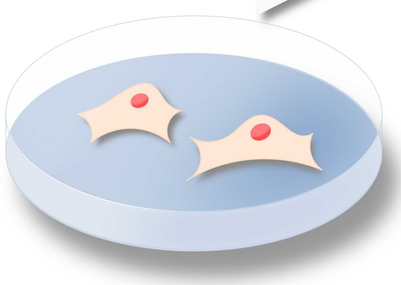


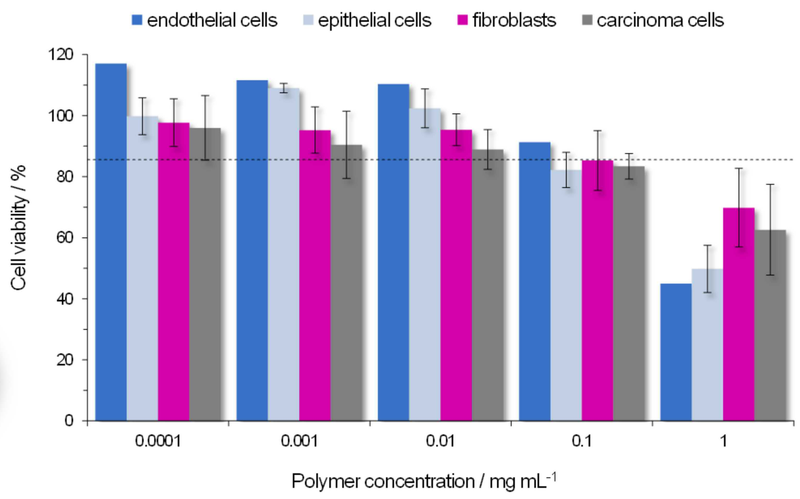




Biocompatibility

86 % of cells survive incubation with 0.1 mg mL^{-1} PGG

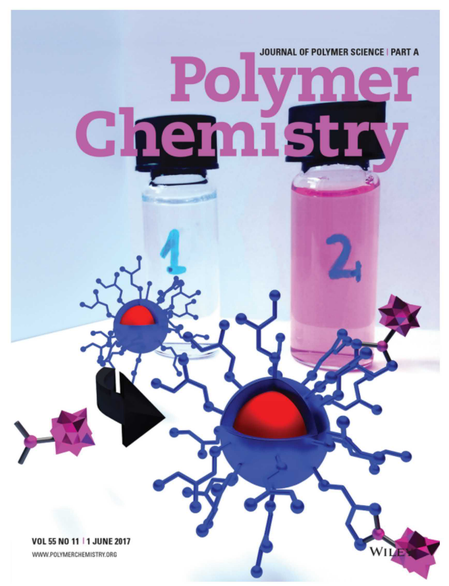




Learn more!

For more information about PGG, check out our article in the Journal of Polymer Science, Part A: Polymer Chemistry.
The article details the synthesis of PGG, its conjugation to polylactide (PLA) and functionalization of self-assembled PGG-PLA particles with boronic acids.
Furthermore, we are working with double-hydrophilic PGG-hyaluronic acid graft copolymers with cleavable arms for use in ophthalmology. These copolymers are intended as a platform for sustained intravitreal drug delivery. Our results regarding the release kinetics of PGG from hyaluronic acid and methods for quantification of polymer-from-polymer release are currently under review for publication.

Article:



Acknowledgments:
We gratefully acknowledge the project funding by the Academy of Finland (grant number: 263573) as well as the funding by the Doctoral Program in Chemistry and Molecular Science, University of Helsinki. Thanks to all the people being involved in this work: A. Korpi, F. Pooch, H. Tenhu, M. Najberg, P. Ilina, M. Bhattacharya, A. Urtti.

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