

From a 3D Vasculogenesis Model to Therapeutic Angiogenesis

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Abstract

The proper functioning of a tissue graft is dependent on its ability to integrate with the host vasculature. Because it is a tightly regulated biological process that requires the precise orchestration of cellular events and soluble signals, the formation of blood vessels from either existing vasculature (angiogenesis) or from progenitor cells (vasculogenesis) is challenging to recreate *in vitro*. Therefore, understanding the factors that drive angiogenesis and vascularization can significantly improve outcomes upon transplantation of tissues or cells.

We recently reported the engineering of polysaccharide hydrogels with mechanical properties spanning those of mammalian tissues through the controlled incorporation of β -sheet structure in α -helical polysaccharides. Through the integration of biological cues that mimic cell-cell and cell-extra cellular matrix (ECM) interactions, cellular environments with well-defined biological and mechanical attributes have been realized. These hydrogels, *in vitro*, have proven to be a powerful three-dimensional screening platform and have enabled the identification of a *mechanobiology* paradigm in the apical-basal polarization and subsequent organization of dissociated endothelial cells into freestanding lumenized tubular structures. Since these hydrogels undergo thermo-reversible gelation near physiological temperature, they can be adapted into a minimally invasive interventional therapy and serve as an instructive environment to promote *de novo* angiogenesis. In ongoing *in vivo* studies, the role of the mechanical aspects of the gel in invoking and controlling angiogenesis has been further elucidated and these results will be presented and discussed in the context of our *in vitro* findings.

Publications

Fibers of carboxylated Agarose for the delivery of antimicrobial ionic liquid

Aurelien Forget, Rotsiniaina Randriantsilefisoa, Florian Miessmer, Vincent Ahmadi, and V. Prasad Shastri, *submitted*.

Mechanically Tailored Agarose Hydrogels through Molecular Alloying with beta-Sheet Polysaccharides

Aurelien Forget, Raphaelle-Anne Pique, Vincent Ahmadi, Steffen Lüdeke, V. Prasad Shastri, *Macromol. Rapid Commun.* **2015**, *36*, 196-203.

Vom Dessert zur Geweberegeneration / From Dessert to Regenerative Medicine

Aurelien Forget, V. Prasad Shastri. *Labor&More* **2014**, *2.14*, 14-19.

Cover article: Polysaccharide hydrogels with tunable stiffness and provasculogenic properties via α -helix to β -sheet switch in secondary structure

Aurelien Forget, Jon Christensen, Steffen Luedeke, Esther Kohler, Simon Tobias, Maziar Matloubi, Ralf Thomann and V. Prasad Shastri, *Proceedings of the National Academy of Sciences of the United States of America* **2013**, *110* (32), 12887-12892.

Surface functionality as a means to impact polymer nanoparticle size and structure

Julia Schneider, Andrew P. Jallouk, Daniela Vasquez, Ralf Thomann, Aurelien Forget, Christopher J. Pino, and V. Prasad Shastri. *Langmuir: the ACS journal of surfaces and colloids* **2013**, *29*, 4092-5.

Template-free tuning of nanopores in carbonaceous polymers through ionothermal synthesis

Pierre Kuhn, Aurelien Forget, Jürgen Hartmann, Arne Thomas, and Markus Antonietti. *Adv. Mater.* **2009**, *21*, 897-901.

From microporous regular frameworks to mesoporous materials with ultrahigh surface area: dynamic reorganization of porous polymer networks

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