



# BIOMATERIALS FROM REGENERATED SILK FIBROIN

NCL Innovations: Solutions from CSIR India

# Technology

- Various novel methods for producing biomaterials from regenerated silk fibroin (RSF)
- A process for the accelerated gelation of RSF, having a porous structure which is free of microbial growth (and can be used as biomedical implants)
  - ▣ This process also lowers gelation time to a few hours instead of several days
  - ▣ Works in a broad pH range of 5 – 7.5
  - ▣ In a wide range of temp. including room temperature (20-70°C)
  - ▣ With porosity ranging from 1-10 microns
- Electrospinning of RSF from an aqueous solution to form 3D porous structures (like non-woven mats) which can be used as scaffolds (for implants) and in wound-dressing, which have improved biocompatibility
- Surface modification of these biomaterials for improved performance (work under progress)

# Applications\*

- In tissue engineering
  - As scaffolds for treating people with diseased or malfunctioned organs
  - As bio-degradable bio-absorbable materials for body joints, cartilage and bone fixtures
  - Ligament tissue engineering (due to lower inflammatory properties) – its superior mechanical properties allow it to be used for Anterior Cruciate Ligament (ACL) found in the knee
- For repair of damaged or destroyed nerves (by regenerating the nerve)
- In wound healing bandages (provides a moist environment to facilitate re-epithelialization, re-modeling of connective tissues and collagenization)
- As controlled drug delivery vehicles
- Ocular treatments- preparation of contact lenses
- Silk fibroin peptides are used in cosmetics due to their glossy, flexible, elastic coating power, easy spreading and adhesion

\*Reddy, R.M. and G.V. Prasad, 2011. Silk-the prospective and compatible bio-material for advanced functional applications. Trends Applied Sci. Res., 6: 89-95.

# Market Potential

- The market for biomaterials such as RSF was predicted to be of \$37.6 billion for 2011 and projected to reach \$64.7 billion by 2015<sup>\*^</sup>
- The global market potential for tissue engineering and regenerative medicines has been expected to exceed \$118 billion by year 2013- mainly in the target potential areas of wound care and orthopaedics.<sup>\*\*</sup>
- With an annual growth of 8.3% through to 2014, the market size for Implantable Medical Devices in US only is believed to be \$33 billion currently.<sup>#</sup>

\* <http://www.the-infoshop.com/report/mama179926-global-biomaterial.html> - viewed 16/05/11

^ <http://www.the-infoshop.com/report/inde180852-glob-biomaterial.html> -viewed 16/05/11

\*\* <http://www.medicalnewstoday.com/releases/141341.php>- viewed 18/05/11

# <http://www.freedoniagroup.com/Implantable-Medical-Devices.html> -viewed 18/05/11

# Value

- Biomaterials with enhanced biocompatibility and biodegradability
- Advantages of RSF biomaterials made through the novel gelation process
  - Gelation in a few hours, instead of several days
  - Works in ambient conditions of temperature and pH
  - With wide range of porosity (1 - 500 nm)
  - Free of microbial growth (superior performance of implants, lower toxicity)
  - Shorter gelation time opens-up the potential spectrum of applications of the materials developed using this method
- RSF biomaterials made from electrospinning from aqueous solution
  - Process is cheaper and faster (as use of aqueous solution instead of organic solvent helps avoid several intermediate steps)
  - Implant that could be reproduced with great consistency and quality

# Technology Status, IP Status

- PCT/ US patent applications filed ([PCT/IN2010/000506](#))
- Demonstrated at lab scale
- Ready to be licensed/commercialized

# Links & References

- Reddy, R.M. and G.V. Prasad (2011) Silk-the prospective and compatible bio-material for advanced functional applications. Trends Applied Sci. Res., 6, Pg 89-95.
- Bettinger, C.J. et al. (2007) Silk Fibroin Microfluidic Devices, *Adv Mater.* 19(5), Pg 2847–2850.
- Harkin, D.G. et al. (2011) Silk fibroin in ocular tissue reconstruction, *Biomaterials*, 32, Pg 2445-2458.
- Collins, A. M. et al. (2009) Bone-like Resorbable Silk-based Scaffolds for Load-bearing Osteoregenerative Applications, *Adv. Mater.*, 21, Pg 75-78.

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# Summary

Technology Summary	
Technology title	Biomaterials from Regenerated Silk Fibroin
Industry /sector	Biomaterials/Tissue engineering
Year of development	2010
Related patents (with links)	<a href="#">PCT application filed</a>
Technology readiness level	Demonstrated at lab scale
Licensing status	Ready to be licensed
Encumbrances	No
Availability	Yes