

Silk Hydrogels for Drug and Cell Delivery

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Introduction

Silk has fascinated humans since ancient times; silk fibres have been used in textiles for more than 5,000 years and for many centuries as a suturing material (Lubec et al. 1993; Omenetto and Kaplan 2010). The remarkable strength and toughness of silk stems from its evolution as a structural engineering material in nature (Vollrath and Porter 2009; Buehler 2013).

Silk is a sustainable and ecologically benign biopolymer that can be manufactured using green processes (Vollrath and Porter 2009). Over the past 25 years, we have seen a tremendous development of both bottom-up and top-down approaches for the generation of silk biopolymers. Specifically, reverse engineering of silk cocoons and the advent of recombinant technologies have been paramount for a better understanding of silks (Chung et al. 2012; Tokareva et al. 2014). For example, molecular simulation studies (Buehler 2013), coupled with dedicated mechanical testing of recombinant and natural silks (Vollrath and Porter 2009), have increased our appreciation of the critical importance of silk's hierarchal structure by which it serves its function (e.g., protects the developing moth in the silk cocoons and catches spider's prey in orb-webs) (Omenetto and Kaplan 2010). Thus, natural silk fibres can serve as blueprints for novel designer polymers.

Today, silk's remarkable physical properties have supported high-end applications, including its use in bulletproof vests (Gatesy et al. 2001), parachute cords (Kluge et al. 2008), composite materials for the aviation industry (Hardy and Scheibel 2009), photonics (Omenetto and Kaplan 2008) and electronics (Kim et al. 2010). The medical