regions in the silk heavy chain (Wray et al. 2011). After degumming, the extracted silk fibres can be used to generate yarns, sutures or woven fabrics. However, the generation of new silk material formats, such as silk hydrogels, typically requires that the extracted silk fibre be reverse engineered into an aqueous silk solution that resembles the silk dope found the silk worm's gland. Therefore, the silk fibre is dismantled with the use of chaotropic agents at elevated temperatures (e.g., 9.3 M LiBr at 60°C for up to 4 hours) to disrupt hydrogen bonding and unfold the silk crystalline domains.

The resulting silk solution is dialysed extensively against water to yield an aqueous silk solution of typically 6% w/v. A more concentrated silk solution can be readily obtained by dialysing silk against a 10% w/v polyethylene glycol solution, which withdraws water from the silk preparation. The aqueous silk solution can be processed into various material formats, such as films, fibres, scaffolds, micro- and nanoparticles, as well as hydrogels (Rockwood et al. 2011) (Fig. 2). Irrespective of the silk format, the material needs to be suited for its intended use. In the following section, we will examine the rationale for using the silk biopolymer for drug and cell delivery.

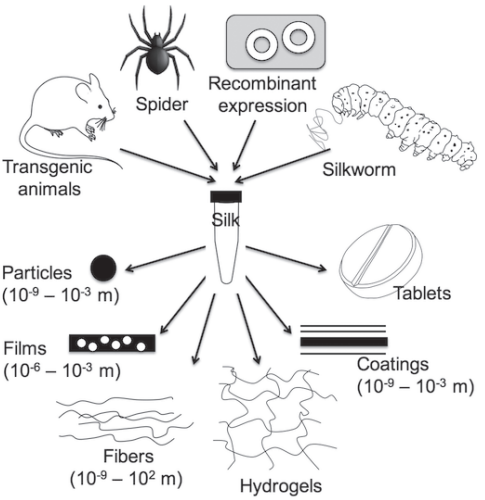

Fig. 2. Diagram of silk sources and silk formats. Numbers in parentheses refer to the approximate sizes of these materials; diameters or thicknesses in the case of particles and films/coatings, respectively (reproduced with permission from (Seib and Kaplan 2013)).

Rationale for Using Silk for Drug and Cell Delivery

A number of important attributes are typically cited in support of using silk for cell and drug delivery, including (i) biocompatibility, (ii) biodegradability, (iii) mild processing conditions, (iv) protection of the payload and (v) approved use in humans. Silk fibres are United States of America Food and Drug Administration (FDA) and European Medicines Authority (EMA) approved biomaterials for use in humans as medical sutures; silk-based surgical meshes have also received FDA/EMA approval. These meshes have been developed by Serica Technologies, Inc. Medford MA,