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Programing Performance of Silk Fibroin Materials by Controlled Nucleation ZHENGWEI CHEN, Physics Department, FOS,National University of Singapore, HONGHAO ZHANG, ZAIFU LIN, YOUHUI LIN, Research Institute for Biomimetics and Soft Matter,Xiamen University,China, JAN H. VAN ESCH, Department of Chemical Engineering, Delft University of Technology, Julianalaan 136, 2628 BL Delft, Netherlands, XIANGYANG LIU, Physics Department, FOS,National University of Singapore, RESEARCH INSTITUTE FOR BIOMIMETICS AND SOFT MATTER TEAM — To examine the mechanism of the network formation of silk fibroin (SF), we adopt mono-dispersed colloidal particles (MDCPs) as well defined foreign substrates to quantify their effect on the primary nucleation of β-crystallites in molecular networks (silk nano-fibrils) and the hierarchical network formation of SF. It follows that MDCPs are capable of accelerating the SF gelation by reducing the multi-step nucleation barrier, which gives rise to a high density of silk fibril domain networks due to the increase of primary nucleation sites. Consequently, through governing the change in the hierarchical mesoscopic structure, the macroscopic performance of silk materials can be controlled directly. As SF hydrogels represent a typical example of weak fibril domain-domain network interactions, the increase of fibril domain density leads to weaker gels. On the other hand, SF fibers correspond to strong fibril domain-domain network interactions, the increase of fibril domain density ends up with much tougher fibers. The knowledge obtained not only provides a facile strategy in controlling the structure and performance of SF materials, but also offers some useful routes to design and functionalize soft materials in general.

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