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Microphase Separation Controlled Beta Sheet Crystallization Kinetics in Silk Fibroin Protein.[1] XIAO HU, QIANG LU, DAVID KAPLAN, PEGGY CEBE, Tufts University — We investigate the mechanism of isothermal crystallization kinetics of beta-sheet crystals in silk multiblock fibrous proteins. The Avrami analysis kinetic theory, for studies of synthetic polymer crystal growth, is for the first time extended to investigate protein self-assembly in beta-sheet rich *Bombyx mori* silk fibroin samples, using time-resolved Fourier transform infrared spectroscopy, differential scanning calorimetry and synchrotron real-time wide-angle X-ray scattering. Results indicate formation of beta sheet crystals in silk proteins is different from the 3-D spherulitic crystal growth found in synthetic homopolymers. Observations by scanning electron microscopy support the view that the protein structures vary during the different stages of crystal growth, and show a microphase separation pattern after chymotrypsin enzyme biodegradation. We present a model to explain the crystallization of the multiblock silk fibroin protein, by analogy to synthetic block copolymers. This model could be widely applicable in other proteins with multiblock (i.e., crystallizable and non-crystallizable) domains.

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