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Study on Conformation Transition of Silk Fibroin by Using FTIR Microspectroscopy

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ABSTRACT: Silk fibroin in one of the most extensively studied materials among the natural biopolymers. An important reason for the interest in this natural biopolymer lies in the fact that it can exist in several conformations, such as random coil and beta-sheet. The silk fibroin membrane cast from an aqueous solution shows mostly random coil conformation, although the physical properties of silk fibroin membrane mainly depend on the intermolecular hydrogen bond, i.e., beta-sheet. It is known that the conformation of silk fibroin can be converted from random coil into beta-sheet by treating with an organic solvent, such as methanol and ethanol. Forming a thin silk fibroin membrane onto BaF2 disc, and then put the silk fibroin membrane into an alcohol circumstance, therefore, the time scale of the conformation transition occurred can be tested. The absorption band of amide I of silk fibroin is obviously changed from ~1650cm-1 to ~1630cm-1 when the conformation transited from random coil into beta-sheet. The intensity-time plots from the difference spectra of increasing b-sheet band at 1618 cm-1 and the decreasing band at 1668 cm-1 for random coil and/or silk I structure were fitted with biphasic exponential decay function. A two-stage mechanism was suggested to explain the conformation transition process, involving a fast stage with the time constant of about 0.5 min in the rapid formation of b-sheet, and a slow stage related to perfection of b-sheet with the time constant of about 5.5 min.