

研究论文

桑蚕丝素蛋白初始结构对其矿化作用的影响

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摘要 以碱金属离子诱导桑蚕丝素蛋白溶液发生构象转变,研究了蛋白质初始结构对其矿化作用的影响. FT-IR, XRD和SEM等测试结果显示,未经任何处理的桑蚕丝素蛋白溶液矿化后形成片状复合物,

其无机相以二水磷酸氢钙(DCPD)为主;而经过K⁺和Na⁺金属离子处理后,桑蚕丝素溶液的结构由无规线团/螺旋构象向 β -折叠发生转变,矿化后成纤维状,并相互结合呈现纳米级的三维多孔结构,

其无机相以热力学稳定的羟基磷灰石(HA)为主.可以认为,丝素蛋白结构转化为较伸展的 β -折叠后,

使得更多的亲水基团暴露在外面,在丝素蛋白分子不断凝聚成纤过程中,HA结晶快速生长并附着在这些微纤上,最终形成纤维状的丝素蛋白/HA复合物.该结果为阐明蛋白质的生物矿化过程及其调控机理提供了理论依据,

同时可以从矿化复合物的形成来反映这些微量元素可能对骨组织形成的影响,

为临床骨组织的修复提供一定的参考.

关键词 [桑蚕丝素](#) [碱金属离子](#) [磷酸钙](#) [羟基磷灰石](#) [生物矿化](#) [蛋白质结构](#)

分类号

Effect of Initial *Bombyx mori* Silk Fibroin Structure on the Protein Biomineralization

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Abstract In this study, we studied the effect of initial *Bombyx mori* silk fibroin structure on the protein biomineralization, where the structural transition was induced by the alkali metal ion treatment. The results from XRD, FTIR and SEM showed that the as-prepared composites formed from the silk fibroin without metal ion treatment had the sheet-like morphology, where the predominant inorganic phase was dicalcium phosphate dehydrate (DCPD). In contrast, the structural transition occurred in the silk fibroin, from random coil/helical structure to β -sheet, after the treatment of K⁺ and Na⁺ metal ions. The as-prepared composites had the fiber/rod-like morphology with the predominant inorganic phase of hydroxyapatite (HA), where the fibers/rods bundled together to form the nano-size, 3D porous network structure. It is thought that there were more hydrophilic groups with outside exposure on the extended β -sheet molecular chains, where HA crystals grew with the aggregation of silk fibroin, and further accreted onto the silk fibroin fibrils through the interaction with the hydrophilic groups. These results may provide some information on the protein biomineralization and its bio-molecular control. Moreover, the results may reflect the role of these trace elements to the bone formation, which are somewhat important for the bone repairing on clinical practice.

Key words [Bombyx mori silk fibroin](#) [alkali metal ion](#) [calcium phosphate](#) [hydroxyapatite \(HA\)](#) [biomineralization](#) [protein structure](#)

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