Quantitative assessment of the deterioration behaviors of ancient silk

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Abstract Silk is a natural material that has been used for over 5,000 years to produce numerous precious textiles. Silk fiber is a polymer composed of sericin and fibroin, which are two types of proteins consisting of C, H, O, N, etc. Before weaving, raw silk is normally subjected to degumming in which the majority of silk sericin has been removed. The degummed silk contains mainly fibroin which composed of amino acids that fold into antiparallel β-sheets crystallites and an amorphous region. The unique structure makes silk one of the most sensitive natural fibers that is easily influenced by deterioration agents. As a result, only a small amount of ancient silk has survived after long-time burial. Therefore, it is of great importance to investigate the degradation behaviors of ancient silk by assessing the ageing and evaluating the stability.

To date, the characterizations of silk degradation are widely studied. The focus shifts from morphological level to molecular level of silk by employing various methods. However, most reported works focused mainly on evaluating the property changes upon the variation of structure and composition of silk. There remains a lack of systematic research on measuring and quantifying the degradation of silk with effective ageing indicators, in order to accurately determine the deterioration status.

In this paper, the deterioration behaviors of two ancient silks were investigated in comparison with the modern silk. XRD, XPS, EPR and ^{13}C CPMAS NMR were employed to measure the crystallinity, oxidation and carbonization degree, variation of amino acid content and content of random coil. The results and findings provided numerical ageing indicators for assessing the deterioration status of ancient silk. The research would be beneficial to determine the structure change and stability of silk, and further provide scientific evidence for the conservation of ancient silk.

Keywords ancient silk; deterioration; quantitative assessment

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