Cross-Linked Collagen Triple Helices by Oxime Ligation

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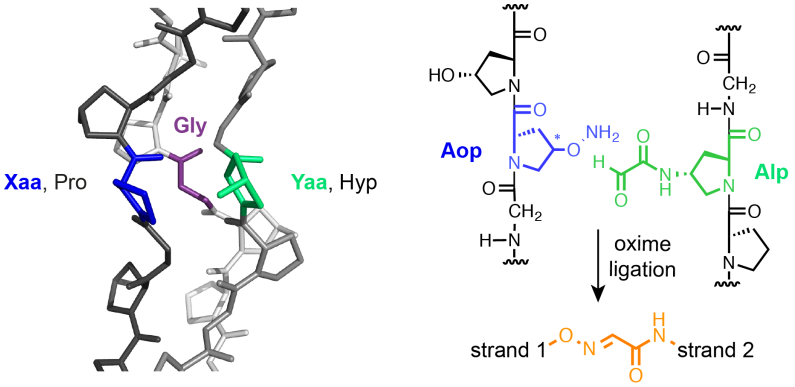
Collagen is the most abundant protein in mammals and the main component of their extracellular matrix.[1,2] The chemical synthesis of collagen is attractive for medical and nanotechnological applications[3] since it can provide access to structurally defined and functionalizable materials.[4,5] However, the bottom-up design of materials mimicking the fibrous structures of natural collagen is hampered by the entropically unfavorable assembly of short single strands into triple helices.[1,2] To lay the foundation for higher-ordered assemblies of collagen model peptides (CMPs), we covalently connected CMPs by oxime linkages between aminooxyproline (Aop)[6] and 2-oxoacetamidoproline (Alp) derivatives placed in neighboring strands. The cross-linked strands folded into collagen triple helices with remarkably high thermal stabilities (T_m ~80°C). The design of the cross-links was guided by an analysis of the conformational properties of Aop, studies on the stability and functionalization of Aop-containing collagen triple helices, and molecular dynamics calculations. Our findings open new opportunities for the design of functional collagen-based materials forming by the sticky-ended assembly of structurally well-defined triple helices.



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