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Stiffness and structure in collagen materials

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Collagen is an important component of biological and natural surgical materials. Flexibility and strength are important properties of these materials in use. Here we investigate some factors that control strength and affect flexibility in these materials and the nano-structural changes that affect these properties. The small angle scattering (SAXS/WAXS) beamline at the Australian Synchrotron is used to measure aspects of the structure of collagen in these solid materials including fibril orientation, D-banding (and fibril extension), intermolecular spacing and the change in the helical turn distance. These measurements make full use of the 2D detector. They are combined with mechanical tests for stiffness and strength. Strength is largely due to collagen fibril orientation in the plane of the material, with highly aligned material strongest. Stiffness is affected by changes in humidity or by infusion with 2-propanol or other alcohols. Bend modulus increases logarithmically with increasing 2-propanol concentration in water. Bend modulus decreases with increasing humidity. Intermolecular spacing decreases with 2-propanol and increases with water content and is strongly correlated with stiffness. The change in intermolecular spacing is due to changes in the hydrogen bond structure between tropocollagen molecules causing closer packing of the molecules within a fibril. These may represent general mechanisms for stiffness and strength in many collagen based materials and tissues.

Speakers Gender

Male

Travel Funding

No

Level of Expertise

Expert

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No

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