Thermal Analysis of Collagen-Like Peptides Using MEMS Microcalorimetry

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Collagen is the most abundant protein in the human body and a major component of skin, tendon, bone, cartilage, and blood vessel walls. Mutations in collagen sequences have adverse effects on the self-assembly of collagen fibrils, resulting in osteogenesis imperfecta (OI) and other bone- and tissue-related illnesses that range from mild to lethal in symptoms. Understanding the mechanisms behind self-assembly of normal and mutated collagen-like peptide chains is an initial step in understanding many bone- and tissue-related diseases in humans.

MEMS Microcalorimetry, developed to measure the thermal properties of small liquid droplets, was used to study the thermal characteristics of normal and mutated collagen-like peptide chains, chains designed to represent some of the mutations found in known disease states. The calorimeter consists of a nickel-based strip heater and a nickel RTD element on a silicon dioxide membrane. The membrane, 200 microns in diameter, is suspended in a silicon frame for thermal isolation. The calorimeters can be used for the measurement of thermal properties, as well as to detect changes in phase or state of the liquid being studied. As such, the microcalorimeters can be used to study the unfolding and self-assembly processes of collagen-like peptide chains. The results may offer insight into the unfolding and self-assembly process of normal and mutated collagen as a step toward improved understanding of the disease as well as future modes of changing these outcomes for clinical benefit.