

Polymer structure in water studied by THz-Raman spectroscopy

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A collagen model polypeptide (Pro-Pro-Gly)₁₀, {(PPG)₁₀} is a polymer that forms a collagen-like triple-helical structure in aqueous solution. Interestingly, this triple helix folding is thermally reversible. However, short collagen peptides like a (Pro-Pro-Gly)₅, {(PPG)₅} cannot form a triple helical structure due to their low molecular weight or length. Gough et al reported that the (PPG)₁₀ adopts a structure in which side chains are mostly exposed to solvent, and the amide group in the backbone forms hydrogen bonds with each molecules, and it was stabilized its helical structure with bound waters [1]. Shikata et al. reported that the hydration number of PPG5 was about 9 per amino acid residue, while that of the PPG10 in the triple helix state in solution was about two per amino acid residue. In the present study, the structure change and hydration behavior of a collagen model polypeptide (PPG)₁₀ and (PPG)₅ were investigated in deuterated water over a wide temperature range.

The super absorbent polymer of acrylate type are widely used for commercialized polymer materials such as baby nappies and adults pads, water-holding materials for plants, and so on. As well known the super absorbent polymer can absorb and retain extremely large amounts of a liquid relative to their own mass. The cross-linked poly(acrylic acid) can form a three-dimensional network structure, and water molecules are held tightly in the network by hydrogen-bonding. The hydration with polymer and the comparison between held tightly water molecules and free water will be discussed.

Spectroscopy in THz region reveals intermolecular interaction such as hydrogen bonding between polymer chains. Especially, in the case of the polymer solution, low frequency Raman spectroscopy is powerful tool for investigating these intermolecular hydrogen bonding. We have investigated intermolecular hydrogen bonding between collagen model peptide and water, super absorbent polymer and water by low frequency Raman spectroscopy. In the present study, the results of the structure change and hydration behavior of a collagen model polypeptide (PPG)₁₀ and (PPG)₅ in deuterated water over a wide temperature range, and the hydration with polymer and the comparison between held tightly water molecules and free water will be discussed.

Reference

[1] Gough CA, Anderson RW, Bhatnagar RS, *J Biomol Struct Dyn*. 15(6):1029-37(1998).

[2] T. Shikata, A. Minakawa and K. Okuyama, *J. Phys. Chem. B*, 113, 43, 14504-14512(2009)