

Preface

Hydrogen- and hydration-sensitive structural biology

In the 21st century, the human genome project has been completed, and human beings have gotten the blueprint of their own life. However, this does not yet mean that we fully understand life, but indicates that we have gotten the map of how to reveal the mystery of life. One of the most important fields today is structural genomics, in which the functions of proteins are analyzed using the results from synchrotron X-ray and NMR protein structure analysis. Proteins express functions by forming three-dimensional structure. The most distinctive features of the functions in living bodies are precisely regulated in comparison with artificial chemical reaction. Structural biology contributes to understand the mechanism of enzyme reaction, information transfer and protein folding in atomic levels, and so on. There is clear evidence that hydrogen atoms and water molecules surrounding proteins and DNA play a very important role in many physiological functions. However, so far it has been difficult in NMR or X-ray crystallographic analysis of a protein to identify all of the hydrogen atoms and the molecules of hydration, even though they play important roles in innumerable biological processes.

Recently several technological innovations, which provide the ability to locate hydrogen posi-

tion and hydration, have been established. These are high resolution (<1.0 Å) synchrotron X-ray crystallography, high resolution NMR and neutron protein crystallography by using a neutron imaging plate. Now is a proper time to establish the new field of structural biology by including the information of protonation and hydration in proteins and DNA using not only neutron diffraction experiments on a protein/DNA single crystal, but also X-ray diffraction and NMR experiments, and computer simulations. To promote the hydrogen- and hydration-sensitive structural biology we have already organized three international symposia in Japan on 'Development of New Structural Biology Including Hydrogen and Hydration' (March 2000, Tokai; October 2000, Mito; December 2001, Tsukuba). The papers published here in this special issue have been presented as invited talks in these symposia. I am absolutely sure that these papers will contribute to the developments in structural biology.

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