

## Crystallization and X-ray Crystallographic Study of Light-Harvesting Chlorophyll *a/b* Protein Complex

Tomoya Hino, Tsutomu Kouyama

Department of Physics, Graduate School of Science, Nagoya University

Light-harvesting chlorophyll *a/b* protein complexes (LHC-II) are the most abundant membrane-spanning proteins in the thylakoid membranes of green algae and higher plants, and function as antenna of solar energy. The major component of LHC-II in higher plants consists of a polypeptide chain of 25 kDa, which binds a nearly equal number of chlorophyll *a* and *b*.

When LHC-II from pea thylakoid membranes is co-crystallized with native lipids, an octahedral crystal exhibiting no birefringence is obtained. Cryogenic electron micrographs of a crystal edge showed that the crystal is made up of vesicular assemblies with a diameter of 250 Å. The composition of the crystallization solution affected the packing manner of the vesicular assemblies, yielding two crystal forms ( $P2_13$  and  $F23$  crystals) that had similar cell dimensions. The  $F23$  crystal diffracted X-rays up to 8 Å resolution. When the diffraction data were analyzed by the molecular replacement method using the previously reported structural model of LHC-II, it was shown that twenty trimers are arranged in the icosahedral lattice. It was also shown that the vesicle has a low-electron-density region with a thickness of 20 Å, which presumably represents a hydrophobic layer of lipid and/or detergent molecules filling the space among the proteins.

The present result demonstrates that the octahedral crystal of LHC-II is made up of the  $T=1$  icosahedral proteoliposomes. This is the second example of membrane proteins that form polyhedral assemblies under crystallization conditions.