Development of soft X-ray microscope in Water Window using laser produced plasma light source

T. Ejima[1*], Y. Kondo[2], Y. Ono[2], T. –H. Dinh[2], T. Higashiguchi[2], T. Hatano[1]

[1] *Institute of Multidiciplinary Research for Advanced Materials, Tohoku University, Sendai, Jappan*

[2], *Department of Electrical and Electronic Engineering, Faculty of Engineering and Center for Optical Research and Education (CORE), Utsunomiya University, Utsunomiya, Tochigi, Japan*

**E-mail: ejima@tagen.tohoku.ac.jp*

Abstracts: *A SX microscope using a laser produced plasma (LPP) light source with heavy metal targets was developed to explore the optimum conditions of the LPP light source in Water Window wavelength region and to examine observation possibility of hydrated bio-cells.*

Wavelength region from 2.3 nm to 4.5 nm is known as Water Window. The light in Water Window wavelength region is suitable to observe bio-cells because it is transparent in water and is absorbed by carbon and nitrogen atoms. Therefore, images of bio-cells show absorption contrast in Water Window wavelength region. Recently, LPP light source using heavy metal target generates broad spectral and high intense light in SX wavelength region [1]. Especially, wavelength regions of the emissions from the plasma using Au, W, Pb, and Bi metal targets are in and around Water Window. Therefore, the LPP light source using these metal targets will become one of SX light sources to observe bio-cells. The purpose of our study is that a SX microscope using the LPP light source with heavy metal targets to explore the optimum conditions of LPP light source in Water Window wavelength region and to examine observation possibility of hydrated bio-cells by the use of the SX microscope.

In this study, a contact-type microscope using a scintillator plate was developed. With the use of the scintillator plate which shows high quantum efficiency and linearity in SX region, SX images can be observed instantly by a visible (VI) microscope. As the results of these features, SX images can be directly compared with VI ones changing the irradiation light.

To demonstrate the performance of the developed microscope, polystyrene beads in water were observed changing the thickness of the water. The diameters of the polystyrene beads in water were 1 μm and 0.4 μm. The thickness of the water was gradually changed from 1.3 μm to 5 μm. The plasma was excited by Nd:YAG laser using a Bi target. The SX light from the LPP light source penetrates the water layer from 1.3 μm to 2.3 μm thick, and the diameter 1 μm of the polystyrene beads was observed.

Reference

[1] Ohashi, H. et al., Appl. Phys. Lett. **104**, 234107 (2014).