Progress and Prospects of X-ray Laser Research in QST

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Abstracts: Recent progress in X-ray laser and application research in National Institutes for Quantum and Radiological Science and Technology (QST) is reviewed. Recently, the soft x-ray laser is mainly used for the observation of nano-scale surface ablation dynamics. In the source development, the x-ray laser using the GRIP scheme is developed in parallel with the application research.

Short pulse x-ray sources become indispensable diagnostic tools in modern science and technology and are widely used in probing substances for new material development, protein crystallography in innovative drug development, and non-destructive x-ray imaging etc. The improvement of the sources is also important subject, and in particular coherent x-rays in both the laser-based and accelerator-based are intensively studied, which enable us to achieve quite high spatial-resolution as the probe and quite intense x-ray as the pump. Besides the laser-driven sources have potentials to downsizing and table-top systems, therefore we carry out the development of fully spatially coherent soft x-ray laser (SXRL) at the wavelength of 13.9 nm and its applications. As an application using the SXRL, we have observed the spallative ablation process by the interaction with SXRL or femto-second (fs) laser. The dynamical processes of the SXRL and/or the fs laser- induced surface modifications come to attract much attention for the micro processing. In the case with SXRL irradiation (13.9 nm, 7ps, ~50 mJ/cm²), we have observed the damage structures and the optical emission from the ablated materials. When focused SXRL pulses were have been irradiated onto the metal surface, we have confirmed damage structures.[1] In the case with fs laser irradiation (795 nm, 80fs, ~1.5 J/cm²), we have observed the surface morphology of fs laser ablation by the SXRL interferometer and SXRL reflectometer. The time resolved image of nano-scaled ablation dynamics of metal surface was observed.[2] In the presentation, we will show the recent progress of application research and x-ray laser development.

- [1] M. Ishino *et al.*, in this conference.
- [2] N. Hasegawa et al., in this conference.