Facility report for the 21st Century COE Synchrotron Light Life Science Center

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(http://www.ritsumei.ac.jp/se/re/SLLS/newpage13.htm)
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MIRRORCLE-20

The tabletop synchrotron MIRRORCLE-20 is optimized as a MIR and FIR beam source for the life science research. We extract whole synchrotron radiation emitted from MIRRORCLE-20 by an aid of a magic mirror and a circular mirror [1-5], which realized more than 10 times higher flux than that of conventional synchrotron (SR). The observed MIR power is as much as 50mWin total. Broadband spectrum from MIRRORCLE meets well with an absorption spectral measurement. The blackbody radiation is useful but not enough for FIR radiation. Two application beam lines are prepared. For MIR a set of grating monochrometer and cooled MCT detector is completed. A step scanning type FTIR and cooled silicon bolometer is prepared for FIR spectroscopy. Studies on a water network structure as well as an interaction of water and proteins or organic materials are undergoing project. Fundamental research on a hyperthermia cancer therapy is carried out in the collaboration with an outside group. Research on organic materials under high pressure is undertaken with the group of the Ritsumeikan University Chemistry Department.

MIRRORCLE-6X

Three years have passed since the portable synchrotron MIRRORCLE-6X [2,6,7] was launched at 21st Century COE Synchrotron Light Life Science (SLLS) Center in Ritsumeikan UNIV. MIRRORCLE-6X is the smallest synchrotron with 60 cm magnet OD, in which 6 MeV electron beam is stored along exactly circular orbit with 15 cm radius. MIRRORCLE-6X provides a large divergence but high brilliance X-ray beam by bremsstrahlung because that is emitted from a micron order tiny target. An X-ray spectrum is ranging from 10 keV to 6 MeV. The brightness of MIRRORCLE-6X is of the order of 10^{10} photons [8]. The total flux exceeds that of conventional SR. Monochromatic X-ray and EUV/Soft-X-ray is also generated by the PXR mechanism from a crystal target and the transition radiation from a thin foil target, respectively.

Many successful experiments using MIRRORCLE-6X, such as X-ray microscope, medical imaging non-destructive testing, cone-beam CT and X-ray fluorescence of heavy elements, were performed. For example, Figure 1 shows medical diagnosis of chest phantom taken by MIRRORCLE-6X [9]. Imitation tumor behind of bone made by urethane (indicated by arrow) is included in the chest phantom. The tumour is clearly recognized by the enhanced edge resulted from the magnified and refraction contrast imaging. Bone is also recognized by the edge. The black spots are cross-section of vessels. MIRRORCLE-6X is useful for X-ray image of not only such living samples but also heavy constructions.

A monochrometer for X-ray diffraction and XAFS is under construction. MIRRORCLE-6X will be developed for further advanced applications.

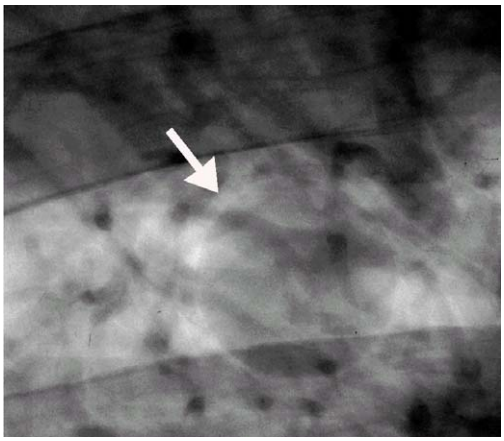

Figure 1. Medical diagnosis of chest phantom (10 times magnified image). Edge enhancement by the refraction contrast is significant. The Cu25μmϕ rod (depth 0.5mm) target is used. Detector is an imaging plate.

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