

PORTABLE SYNCHROTRON HARD X-RAY SOURCE "MIRRORCLE-6X" FOR X-RAY IMAGINGS

Hironari. Yamada, Daisuke Hasegawa¹, Tohru Hirai, Yoshiko Okazaki, Makoto Sasaki, Taichi. Hayashi¹, and Takanori. Yamada¹
Ritsumeikan University, Synchrotron Light Life Science Center,
1-1-1 Nojihigashi, Kusatsu-City, Shiga 525-8577, Japan
¹Photon Production Lab. Ltd., 4-2-1 (808) TakagaiChoMinami,
Omihachiman-City 523-0898, Japan

MIRRORCLE-6X is a portable synchrotron composed of a 6-MeV microtron injector, and a 60cm outer diameter exactly circular synchrotron ring made of a normal conducting magnet. The injection is performed at 400 Hz repetitions by 100 mA injector peaks current that lead to 3A initially accumulated current. X-rays are generated by a collision of the relativistic electron beam and a small target placed inside the circulating beam. The generated X-ray energy is dominated at around 30-300keV, and the total flux in the 0.1% bandwidth and ± 85 -mrad spreads is 1000 times higher than a conventional synchrotron light source. A few μm wide target, which defines the X-ray emitter size, produces extremely fine resolution edge enhanced images. Due to the small emitter size the brilliance of MIRRORCLE reaches 10^{16} photons/[s, mrad², mm², 0.1% band width] at any point within ± 85 -mrad. The image field can be more than 30 cm wide at 2 m distances from the source point. This machine provides highest quality non-destructive testing of heavy constructions. Due to the phase contrast effect this machine also enables imaging of soft tissues. When the imaging device is set at the distance from the sample we can take magnified images. We have already obtained 10 times magnified fine resolution images, and are challenging to 100 times magnification that forms a novel X-ray microscope without optical elements. MIRRORCLE-6X opens up new frontiers of X-ray imaging in medical, biological, commercial and industrial uses.

The observed X-ray beam quality, brilliance, coherence, and challenge to the sub-micron size target will be discussed.