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In-vivo 3D PIXE-micron-CT imaging of Drosophila using contrast media

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For the research field of biology and medicine, it is very useful to develop the technology in which an interior of small animals can be observed in-vivo and with a high resolution of several micron meters. For this purpose, we have developed a 3D CT with micrometer resolution. The system comprises a point X-ray source, a rotating sample stage and a high-speed X-ray CCD camera. A microbeam system was used as a monoenergetic μ-X-ray source by bombarding pure metals. We called the system PIXE-micron-CT. Characteristic X-rays from a pure metal target bombarded with a few MeV proton micro-beams can be used as a point source of quasi-monochromatic X-rays.
We have applied PIXE-micron-CT to observe organs in a body of a living Drosophila, which is popularly used in various fundamental studies, such as gene research. The internal structure of living Drosophila was obtained in the different growth stages. The CT images of living Drosophila were much different from those of dead or formalin fixed ones [1]. Although the organs in thorax are clearly recognized in living Drosophila, the digestive organs in abdominal were not clearly seen except the rectum and the Malpighian tubule.
In this study, we tried to photograph digestive organs inside abdominal part, emphatically by applying radiographical contrast agent to Drosophila. Considering harmlessness and linear attenuation coefficient compared with physical tissues, BaSO4 compound was introduced as contrast agent. Iron was selected as an X-ray target instead of titanium which was used in the previous study considering its high linear attenuation coefficient to BaSO4. The 3D ventriculus and rectum in abdominal of living Drosophila images were obtained. The ventriculus images were never obtained without using radiographical contrast agent. The PIXE-micron-CT can provide in-vivo 3D-CT images that reflect correctly the structures of each living organ and is expected to be very useful in biological research.
[1] K.Ishii et.al., X-Ray Spectrom. 2011, 40, 191–193

Primary author: Dr MATSUYAMA, Shigeo (Department of quantum Science and Energy Engineering, Tohoku University, Sendai, Japan)

Co-authors: Prof. TERAKAWA, Atsuki (Department of quantum Science and Energy Engineering, Tohoku University, Sendai, Japan); Prof. ISHII, Keizo (Department of quantum Science and Energy Engineering, Tohoku University, Sendai, Japan); Mr FUJIKI, Kota (Department of quantum Science and Energy Engineering, Tohoku University, Sendai, Japan); Dr FUJIWARA, Mitsuhiro (Department of quantum Science and Energy Engineering, Tohoku University, Sendai, Japan); Mr HAMADA, Naoki (Department of quantum Science and Energy Engineering, Tohoku University, Sendai, Japan); Mr OHKURA, Satoru (Department of quantum Science and Energy Engineering, Tohoku University, Sendai, Japan); Mr HATORI, Yoshinobu (Department of quantum Science and Energy Engineering, Tohoku University, Sendai, Japan); Mr NOZAWA, Yuichiro (Department of quantum Science and Energy Engineering, Tohoku University, Sendai, Japan)

Presenter: Dr MATSUYAMA, Shigeo (Department of quantum Science and Energy Engineering, Tohoku University, Sendai, Japan)

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