



Contribution ID: 1900 Contribution code: MOPM133

Type: **Poster Presentation**

Gamma-ray-induced positron annihilation spectroscopy at UVSOR-III BL1U

Monday, 8 May 2023 16:30 (2 hours)

We are developing gamma-ray-induced positron annihilation spectroscopy (GiPAS) using ultra-short pulsed gamma rays at the UVSOR synchrotron facility in Japan. The gamma rays with the pulse width of picosecond range are generated by 90-degree inverse Compton scattering between a 750 MeV electron beam and an 800 nm laser. As the energy of the gamma rays is 6.6 MeV, gamma-ray irradiation produces positrons by pair production inside the material. Generated positrons localize on atomic-scale defects in solid crystals, such as vacancies, dislocations, and vacancy clusters. Positronium, the bound state of an electron-positron pair, localizes in vacant space caused by the free volume in polymers. Therefore, positrons are excellent probes of the nanostructure of these materials. Furthermore, the circularly polarized gamma rays generated by a circularly polarized laser can produce spin polarized positrons. The spin polarized positrons provide additional information about the electron spins around defects. GiPAS is currently available for users in UVSOR-III. In this conference, we will present a generation method of the ultra-short pulsed gamma-rays and details of GiPAS*.

Funding Agency

Footnotes

- Y. Taira et al., Rev. Sci. Instr. 93 (2022) 113304.

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Yes

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Session Classification: Monday Poster Session

Track Classification: MC2: Photon Sources and Electron Accelerators: MC2.T26: Photon Beam Lines and Components