Contribution ID: **21** Type: **Contributed Oral**

Transmission Muon Microscopy and Scanning μSR Microscopy

Tuesday, 22 July 2025 11:20 (20 minutes)

Muon microscopes [1-3] under development at J-PARC are reported. The transmission muon microscope (TμM) is an analog of a transmission electron microscope (TEM). By employing the strongest penetration power of muons into materials, the TμM allows us to visualizes the 3-dimensional distribution of electromagnetic field in objects much thicker compare to TEMs. This capability is useful to improve power-devices, such as power-semiconductor devices, RF-semiconductors, ceramic capacitors, magnets, piezo-devices, and so on by visualizing their internal electric- or magnetic- fields. We are constructing the 5MeV TμM which employs a muon-cyclotron to accelerate ultra-slow muon-beam to 5 MeV. One of the key technologies is a muon-beam-cooling to increase brightness of the beam. We are constructing a multi-step beam cooling system which produces polarized muon-beam that can be focused into a 30 nm spot. As an application of it, we are also developing a scanning muon spin rotation microscope (SμSRM) which is an analog of the scanning electron microscope (SEM). By measuring the μSR-spectrums point by point, the SμSRM maps the μSR-spectrums in three dimensions with a resolution of 30 nm.

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References:
[1] Y. N., Kotaibutsuri 55(6) (2020), p.231-244.
[2] Y. N., Y. Miyake, Isotope News 773, (2021), p.31-36.
[3] Y. N., K. Shimomura, J. Cryst. Soc. Jpn. 65 (2023) p.33-41.

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Funding Agency

MEXT Grant-in-Aid for Scientific Research(S) 24H00028

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No

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Session Classification: Oral Contributions

Track Classification: Beamlines and instruments