Muonic atom formation on low pressure carbon oxide samples by using low energy negative muon beam

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Muonic atom is an atomic system which has a negative muon substituted an electron. Muonic atom formation processes are influenced by chemical environment such as molecular structure (chemical effect), and these processes can be understood through muonic X-ray measurement emitted after muonic atom formation. However, these processes still have not been well investigated. To reveal the chemical effect on muon capture processes, we performed muon irradiation experiment in an ideal condition. In this study, low pressure simple carbon oxides ; CO, CO_2 and COS, were used for muon irradiation samples.

All experiments were performed at D1-Port in Muon Science Establishment (MUSE), J-PARC. Sample gases below 1 atmosphere were put into a gas chamber and irradiated during 5 to 20 hour with 18.8MeV/c low momentum negative muon beam. Muonic X-rays were measured by germanium semi-conductor detectors.

From analyzing Lyman series muonic X-ray, we estimated the muon capture probability of each atom and the initial quantum state of captured muon. In a case of a negative muon captured by carbon atom, muon capture process, which is reflected in a relative capture probability with oxygen atom and in an initial quantum state, differs among three samples [1].

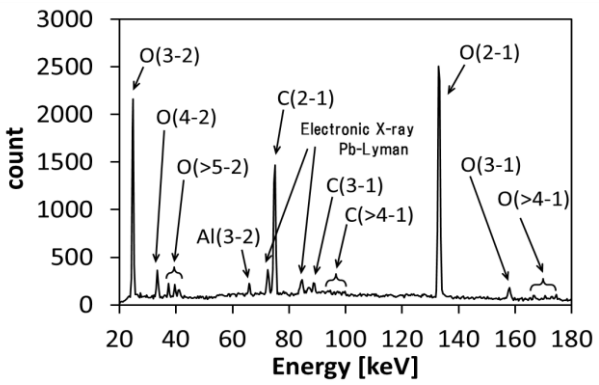

Fig.1 Muonic X-ray spectra of CO_2 sample.

References

[1] G. Yoshida et. al., Submitted to Journal of Radioanalytical and Nuclear Chemistry