Contribution ID: **131** Contribution code: **P-THU-2** Type: **Poster**

Sodium Diffusion in Hard Carbon Studied by Small-Angle Neutron Scattering and Muon Spin Relaxation

Thursday, 1 September 2022 17:40 (20 minutes)

The recent surge of Li-ion batteries has triggered an increased interest to investigate Na-ion battery materials [1,2], because Na is more abundant than Li, resulting in lower material costs. Although many Na transition metal oxides are available as a cathode material for the Na-ion battery, there is, at present, no suitable anode material [1]. The most common anode materials for the Li-ion battery are not compatible for the Na-ion battery, because graphite is electrochemically inactive in an intercalation and deintercalation reaction of Na^+ ions.

Since non-graphitizable carbon (hard carbon) is electrochemically active as a Na insertion host, hard carbon is heavily investigated as an anode material for the Na-ion battery. However, the relationship between the structure of hard carbon and dynamics of Na insertion is still not fully clarified despite huge efforts in the past decade [2]. We have therefore attempted to study the microscopic structural nature of sodium intercalated hard carbon (NaC_x) with small-angle neutron scattering (SANS) and the dynamics of Na diffusion in NaC_x with muon spin rotation and relaxation (μ^+SR).

The transverse field μ^+SR measurements on NaC_x clearly showed a motional narrowing behavior above around 150 K, which indicates that Na+ starts to diffuse above 150 K. The zero field and longitudinal field measurements clarified the presence of the two muon sites ($\mu1$ and $\mu2$). Since the Na concentration around the $\mu1$ site is higher than that around the $\mu2$ site, the $\mu1$ site locates in the graphene layer and the $\mu2$ site in the amorphous region [3]. At the presentation, we will also discuss the results of SANS on NaC_x.

[1] N. Yabuuchi *et al.*, Chem. Rev. **114**, 11636-11682 (2014).
[2] K. Kubota *et al.*, Chem. Mater. **32**, 2961-2977 (2020).
[3] K. Ohishi *et al.*, ACS Phys. Chem. Au **2**, 98-107 (2022).

Primary author: Dr OHISHI, Kazuki (Neutron Science and Technology Center, CROSS)

Co-authors: Mr IGARASHI, Daisuke (Tokyo University of Science); Dr TATARA, Ryoichi (Tokyo University of Science, Kyoto University); UMEGAKI, Izumi (IMSS, KEK); NISHIMURA, Shoichiro (KEK IMSS); Dr KODA, Akihiro (Institute of Materials Structure Science, High Energy Accelerator Research Organization(KEK)); Prof. KOMABA, Shinichi (Tokyo University of Science, Kyoto University); SUGIYAMA, Jun (CROSS Neutron Science and Technology Center)

Presenter: Dr OHISHI, Kazuki (Neutron Science and Technology Center, CROSS)

Session Classification: Posters

Track Classification: Energy materials