



Figure 6: Neutron diffraction measurement facility at the BL-19 (TAKUMI) of J-PARC MLF.

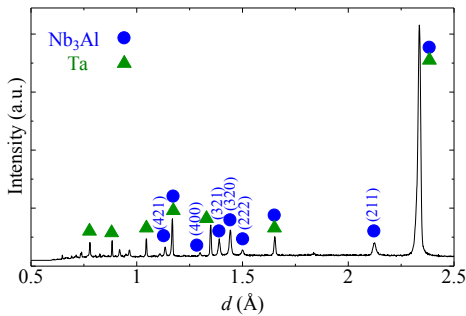


Figure 7: Diffraction peaks of RHQ-Nb₃Al with Ta-matrix measured at TAKUMI, J-PARC MLF.



Figure 8: Cryogenic load frame up to 50 kN from 6 K to 300 K.

- Three-dimensional strains of the superconducting wire can be simultaneously determined by using a pair of 90° detector banks.
- Strains of each ingredient can be determined by using several diffraction peaks measured simultaneously.
- Even small strains can be measured with its high resolution.

- Thanks to high penetration depth of neutrons into the sample, strain distribution inside the massive coil sample can be obtained.

In collaboration with NIMS, JAEA and Tohoku University, a series of neutron diffraction measurement for the stress/strain study has been started with a long-term viewpoint. Preliminary measurement of the RHQ-Nb₃Al wires with different matrixes at room temperature was made in 2010. Figure 7 shows diffraction peaks of the Ta-matrix wire as a typical case. It was observed that residual strains of Nb₃Al crystal were varied according to matrix materials.

For the neutron diffraction measurement at cryogenic temperature under loading, KEK in collaboration with JAEA has newly developed a cryogenic load frame that can apply the tensile load up to 50 kN in the temperature range from 6 K to 300 K, shown in Fig. 8. This cryogenic load frame can provide different conditions to the samples with changing the load and the temperature. Not only sole superconducting wires or tapes, but also bulk samples like epoxy-impregnated Rutherford cable stacks simulating the coil can be measured with this cryogenic load frame.

In parallel, experimental study on *J_c* behaviors under different stress/strain has been also started at High Field Laboratory in Tohoku University. Both experimental results of neutron diffraction measurement and *J_c* measurement under stress/strain will be inseparably analyzed. Knowledge and understanding from this study will improve the mechanical design of high field superconducting accelerator magnets and help to precisely predict its performance limit.

SUMMARY

KEK has promoted the R&D towards high field accelerator magnet. Development of RHQ-Nb₃Al superconductors aiming to be applied for the HL-LHC has been emphasized. The latest Ta-matrix wire showed better low field instability even though non-copper *J_c* is smaller than that of Nb₃Sn-RRP. Magnet technology for RHQ-Nb₃Al cable under very severe radiation environment is underway. Especially, development of the cyanate ester resin for the accelerator application is highlighted. For the long-term R&D, experimental study on stress/strain sensitivity has been launched.

REFERENCES

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