§15. Flux Pinning Properties of Defects Nucleated by Neutron Irradiation in A15 Type Superconductor A Combined NIFS System

Kiuchi, M., Matsushita, T. (Kyutech),
Nishimura, A.

We have investigated the flux pinning properties of defects nucleated by neutron irradiation in nuclear fusion reactor. It is empirically known that the improvement of the critical current density in the irradiated specimen is attributed either to increase in the flux pinning force by the nucleated defects, or to increase in the upper critical magnetic field. However, it has not yet been clarified which contributes mainly to the improvement.

On the other hand, one of the most important properties of the flux pinning mechanism is *E*-*J* properties. This property can be estimated by the relaxation measurement[1)]. In this paper, the relaxation of magnetization was measured for Nb_3Sn, and the validity of this measurement is discussed.

The measured sample is a bronze route Nb_3Sn wire. The outer diameter of the strand is 0.7 mm and the matrix is niobium. The filament diameter is about 4.6 μm and number of filaments is about 4900. The sample was cut for DC magnetization measurement by a SQUID magnetometer, and it was 2 mm. The critical temperature was 17.7 K. The DC magnetization and its relaxation under the magnetic field normal to a length of the wire were measured using SQUID magnetometer.

The Magnetization curve at 4.5-15 K is shown in Fig. 1. The obtained result at hysteresis of 4.5 K is the same with previous reported result[2)].

The relaxation of magnetization at 2.0 T in 4.5K and 10K is shown in Fig. 2, where the initial magnetization M_0 was determined by extrapolating the relaxation curve form the time range of 10^2-10^3 s to t = 1 s. The relaxation rate increases monotonically with increasing temperature. Even at low temperature, the relaxation of the magnetization can be confirmed. The increasing of relaxation rate is considered to be caused by the flux creep. It is found that the relaxation of magnetization can be estimated to be the critical current properties at low-temperature.

The magnetization and its relaxation for Nb_3Sn wire was measured, and discussed the validity of this estimation. It was found that the relaxation rate can be estimated by this measurement. In the future, the *E*-*J* curves at various temperatures and magnetic fields will be estimated using the relation between $J \propto M$ and $E \propto dM/dt$. The effect on critical current density properties of neutron irradiation will be discussed.

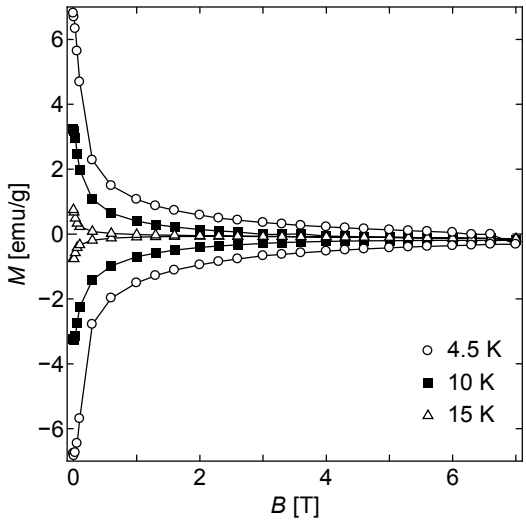

Fig. 1. Magnetization curve at 4.5-15 K.

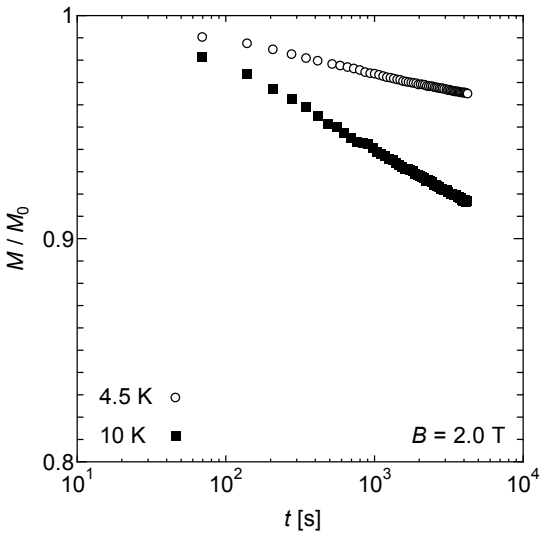

Fig. 2. relaxation of normalized magnetization at 2.0 T in 4.5K and 10K.

1) Himeki K. *et al*., Physica C **468** (2007) 1674.
2) Nishimura A. *et al*., Abstract of CSJ conference, Vol. 83 (2010) p. 166.