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Performance test for the quenching furnace in high magnetic fields

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Magnetic field influences the recrystallization, phase transformation, grain alignment, and so on [1,2]. So far, although in-field annealing effects on the magnetic materials have been reported, there are few reports for the quenching techniques in high magnetic fields. In this study, we developed the compact quenching furnace utilizing for the cryogen-free superconducting magnet (CSM). The performance test of the furnace is performed in high magnetic fields.

The furnace consisted of a water-cooled jacket, quenching water bath, nichrome heater, a DC supply, and the chiller. The quenching water bath was at the bottom of the furnace. The furnace can be inserted to the CSM with 52 mm room temperature experimental bore. The sample is heated up to 773 K by non-inductive nichrome heater. When the sample is quenched, the water bath moves up to the sample position. Thus, the sample position does not change during the quenching.

For the performance test of the furnace, the cooling rate during the quenching was evaluated in magnetic fields. Fig.1 shows the time dependence of the sample temperature at the quenching from 643 K in 0 T and 15 T. The cooling rate did not change with application of 15 T. The cooling rate from 643 to 373 K was about 40 K/s. In this presentation, the quenching effects on ferromagnetic MnBi in magnetic fields up to 19 T will be also shown.

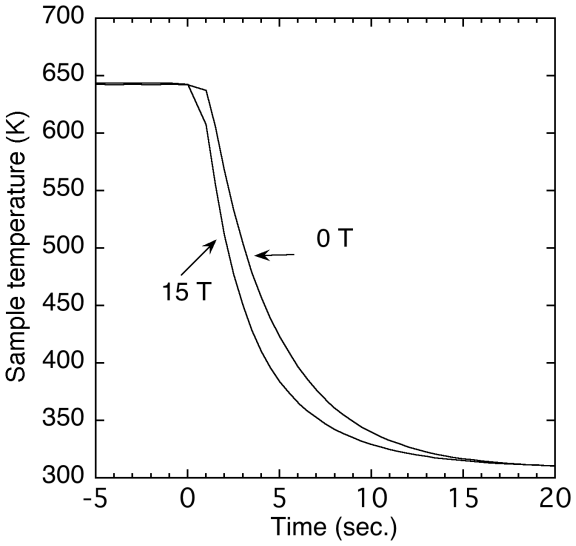

Fig.1. Time dependence of the sample temperature at the quenching from 643 K in a zero fields and in 15 T.

[1] M. Shimotomai and K. Maruta, Scr. Mater., 42, 499-503 (2000)

[2] Y. Mitsui et al., Mater. Trans. 54, 242-245 (2013).