AC Loss Property of Two-dimensional Array of REBCO Superconducting Tapes and Pancake Coils

*Hiromasa Sasa[1], Yuuki Himeno[1], Takaemi Suenaga[1], Hiroshi Miyazaki[1], and Masataka Iwakuma[1]

[1] *Kyushu University, 744 Motooka, Nishi, Fukuoka, Fukuoka, 819-0395, Japan*

Abstract

AC losses in applied superconducting machines causes degradations of machine efficiency, current capacity of superconducting wire, and safety of operation. Although $REBa_2Cu_3O_y$ (REBCO) superconducting tape remains good current capacity even in magnetic field, the AC loss of REBCO tape has complicated property owing to a high aspect ratio of its cross section. Accurate estimation of the AC loss is indispensable to design an efficient, safe, lightweight superconducting machine, especially for aircraft application. Our goal is to realize an accurate estimation of the AC loss in fully superconducting motor for aircraft application. To achieve this goal, we have investigated the AC loss property of REBCO tapes for various conditions. The AC loss under low magnetic field condition is attributed to the shielding effect; therefore, the AC loss is influenced by the winding configuration: the number of turns, the distance between the neighboring superconducting layer, etc. Previously, we have investigated the AC loss of vertically stacked REBCO tapes [1, 2] and horizontally arranged REBCO tapes [3]. As a next step, we have addressed AC loss property of a two-dimensional array of REBCO tapes. Such a geometry can be regarded as a cross section of stacked racetrack coils incorporated in practical applications. Electromagnetic analysis based on finite element method and experimental measurement were conducted to investigate the detailed property of the AC loss. Figure 1 shows the calculated results. The width and thickness of the superconducting layer are 1.9 mm and 2.5 μm, respectively. In addition, we fabricated various type of coil samples and measured the AC loss of them. Those samples have different configurations of the turn number, the gap between stacked coils, etc. The sample coils were immersed in liquid nitrogen and were energized by AC power supply. The coil voltage attributed to AC loss was measured. The measured and calculated result will be reported on ISS2025.
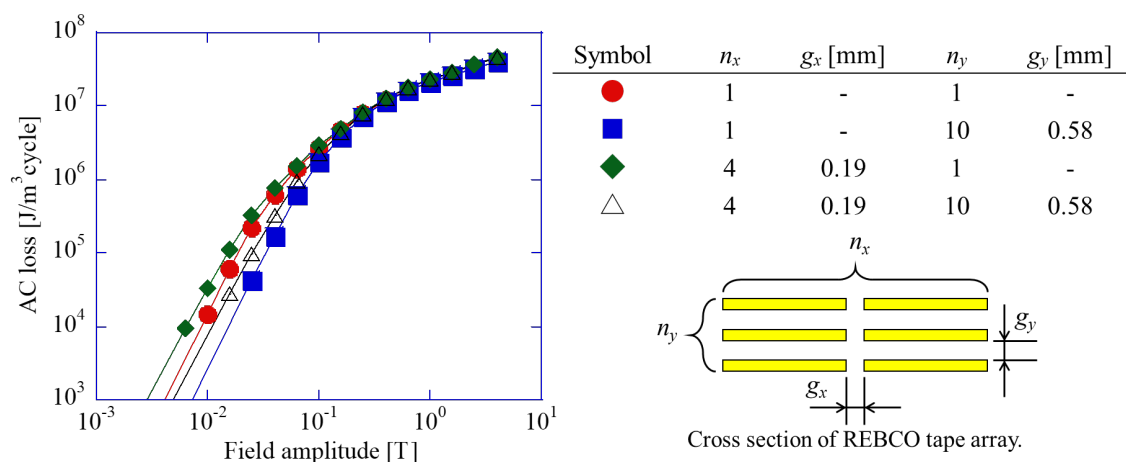
Figure 1. Calculated AC loss of REBCO tape array.

References

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