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Development of Conduction-cooled Superconducting Split Coil for Metal Melting by DC Induction Heating

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We already reported the capability of DC induction heating with the superconducting magnet to supply melting metal of required amount in a short time to the die-casting, in 2015. Many of complex geometries of aluminum profiles for automotive, transportation and industrial equipment are formed by the die-casting, and highly efficient metal melting technology for die-casting is required. We performed a metal melting experiment with the small examination equipment, which consisted of a motor, a heat insulation structure, a rotating shaft, a specimen holder, a frame and incidental devices, using a large low-temperature superconducting magnet, then. About 0.77 kg aluminum pipe was rotated in a DC magnetic field, ranging from about 1 T at the nearest point to 0.4 T at the furthest point, by the examination equipment. Aluminum melting in the sample holder was observed after the rotation of 1,200 rpm in 90 second. In order to obtain better distributed and stronger magnetic fields, the superconducting split magnet, using REBCO coated conductors, was designed and manufactured. The magnet contains six rectangle shaped double pancake coils with the short and long side of about 260 mm and 330 mm. The inductance of each coil was about 200 mH. Then the superconducting coils were cooled by the conduction cooling and generate the magnetic field for the aluminum heating examinations. The detailed design and the performance of the magnet for aluminum melting will be discussed.

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