Introduction

Background

The magnetic billet heating technique by rotating aluminum rods in a DC magnetic field achieved large heating capacity with high efficiency for an induction. It is a kind of the commercializing of HTS equipment.

Preparation of REBCO Rectangle Shaped Coils

In order to obtain a large bore for the aluminum heating examinations, a split coil structure was chosen to generate a magnetic field widely. The split coil pair was designed to be comprised of three rectangle shaped double pancake coils on both sides to generate a strong magnetic field in the cylinder space of about 300 mm in diameter.

Preparation and Evaluation of REBCO Split Coil

The split coil pair was comprised of three rectangle shaped double pancake coils on each side.

Aluminum Melting Experiment

In order to verify the capability of the REBCO split coil, we performed an aluminum melting test using the small examination equipment.

Conclusion

In order to obtain a large magnetic field for the aluminum melting examinations, we designed, prepared a split coil.

1. The split coil was comprised of three rectangle shaped double pancake coils on both sides. A coil winding contains about 700 m of REBCO tapes. The arrangement of six coils was determined by their transport properties at liquid nitrogen temperature.

2. The split coil pair was cooled by conduction-cooling and evaluated the coil-properties by excitation. It was confirmed that the split coil successfully generated the magnetic field according to the design.

3. The temperature of the coil was guessed about 50 K based on the critical-current magnetic-field characteristic of the tapes used in these coils because the critical electric current of the coil was 120A.

4. We observed the aluminum melting although that was insufficient, after the rotation of 1,200 rpm in 100 second, with coil current of 114 A in the aluminum melting test.

These results suggested the effectiveness the REBCO split coil to the aluminum melting and there are any room to improve the split coil especially the conduction-cooling.

Acknowledgment

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Former work

It was confirmed that DC induction heating, using metal superconducting magnet, had a capability to melt aluminum materials in a short while.

Although 0.77 kg aluminum pipe specimen was achieved in melting after the rotation of 1,200 rpm for 90 seconds, in a magnetic field distributed from 0.5 T to 0.45 T.

Specifications of rectangle shaped YBCO-coil Structured DP Coil

<table>
<thead>
<tr>
<th>Superconducting wire type</th>
<th>Copper plated YBCO tape (SuperC Japan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire length</td>
<td>700 m (including 3 parts)</td>
</tr>
<tr>
<td>Width / Thickness of tape</td>
<td>6.0 mm / 100 mm</td>
</tr>
<tr>
<td>Critical current of wire</td>
<td>&gt; 150 A</td>
</tr>
<tr>
<td>Number of turns for a DP coil</td>
<td>About 700</td>
</tr>
<tr>
<td>Inner/Outer short side</td>
<td>150 / 350 mm</td>
</tr>
<tr>
<td>Inner/Outer long side</td>
<td>220 / 390 mm</td>
</tr>
<tr>
<td>Coiling</td>
<td>20 m thick austenitic stainless steel tape</td>
</tr>
<tr>
<td>Thickness</td>
<td>1 mm</td>
</tr>
</tbody>
</table>

Comparison of measured magnetic field and analysis result of the split coil pair at the coil current of 120 A. The measured magnetic fields almost accorded with the analysis results.

1200 rpm, 90 seconds

Comparison of measured magnetic field and analysis result of the split coil pair at the coil current of 120 A. The measured magnetic fields almost accorded with the analysis results.

Coil current dependence of the generated magnetic field at various points in the split coil bore.

"It is inferred that the DP coils were formed without degradation of transport properties. The characteristic unevenness of the DP coils was managed in the arrangement of the split coil."