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FORMATION OF DEOXIDIZATION PRODUCTS IN IRON INGOT BY THE ADDITION OF Al, Si, AND/OR Mn

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The objective of this work is to examine the morphology, composition, and distribution of deoxidation products in iron and iron-10% Ni alloy ingots. The deoxidation agents Si, Mn, Al, and their mixtures are selected to investigate the formation mechanism of the deoxidation products and to compare the differences of oxide formation among these agents in microgravity.

The shape of the sample has been changed from a 12 mmϕ sphere to a capillary type with 5 mmϕ and a 25 or 10 mm length. As illustrated in Figure 1 the 25 mm sample is to be placed parallel with the axial direction of the Large Isothermal Furnace (LIF) and the 10 mm sample is set at a right angle to the axial line to check the effect of heat flow during solidification.

The samples are set in the A1203 crucible first, then the crucible is inserted into the 22 mmϕ, 40 mm long BN chamber. Four sets of BN chambers (two sets for 25 mm samples and two sets for 10 mm samples) are put into the Mo container as shown in Figures 1-3. Finally, the Mo container is set into the Ta container. Both Mo and Ta containers are sealed by EB welding.

The profile for heating and cooling is as follows: the container is heated to 1550 °C for about 50 min; after the desired temperature is reached the container is heated for an additional 3 min, and then cooling starts. The power supply constantly provides 700 W during heating.

Iron with three levels of oxygen content is prepared: 10, 50, and 300 ppm. Deoxidizing elements Al, Si, and Mn are alloyed with 5N iron independently and are also coupled with each other; these seven kinds of deoxidizers are then rolled into a sheet about 0.2 mm thick. These 4.95 mmϕ iron bars and deoxidizer sheets are inserted into the alumina crucible layer by layer like a sandwich. The layered sample is capped with an alumina disc, on which light pressure is applied by coiled fine Ta wire in order to fill up the vacant space between the BN chamber and the cap. In this way the alumina cap is expected to move with the expansion and shrinkage of the sample so as to avoid the occurrence of Marangoni effects. The shapes of BN chambers are shown in Figure 2. For the 10 mm sample a BN cylinder with three holes to set alumina crucibles is inserted. A total of 12 samples can be examined in space.

After the experiment in space, the tested specimens are going to be analyzed by the use of the latest physical and/or chemical analytical equipment, and the information obtained will be a great help for the comprehension of the formation of oxide inclusion in steel for practical purposes, and also for the study of the solidification mechanism theory in the theoretical field.

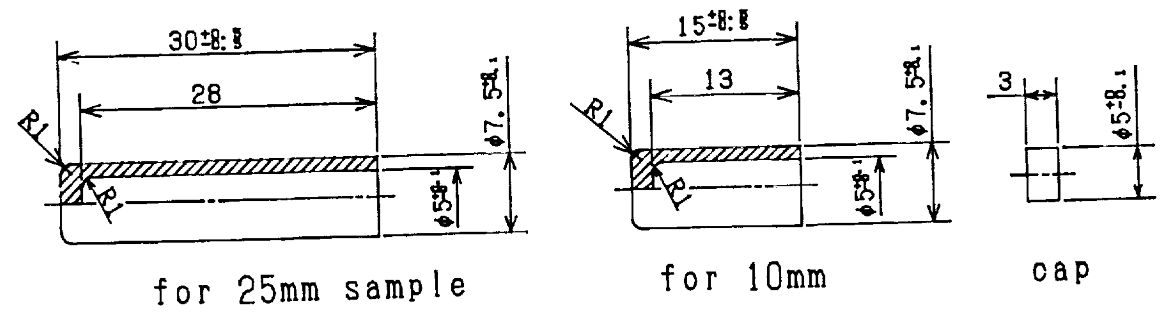

Figure 1. Alumina crucible.

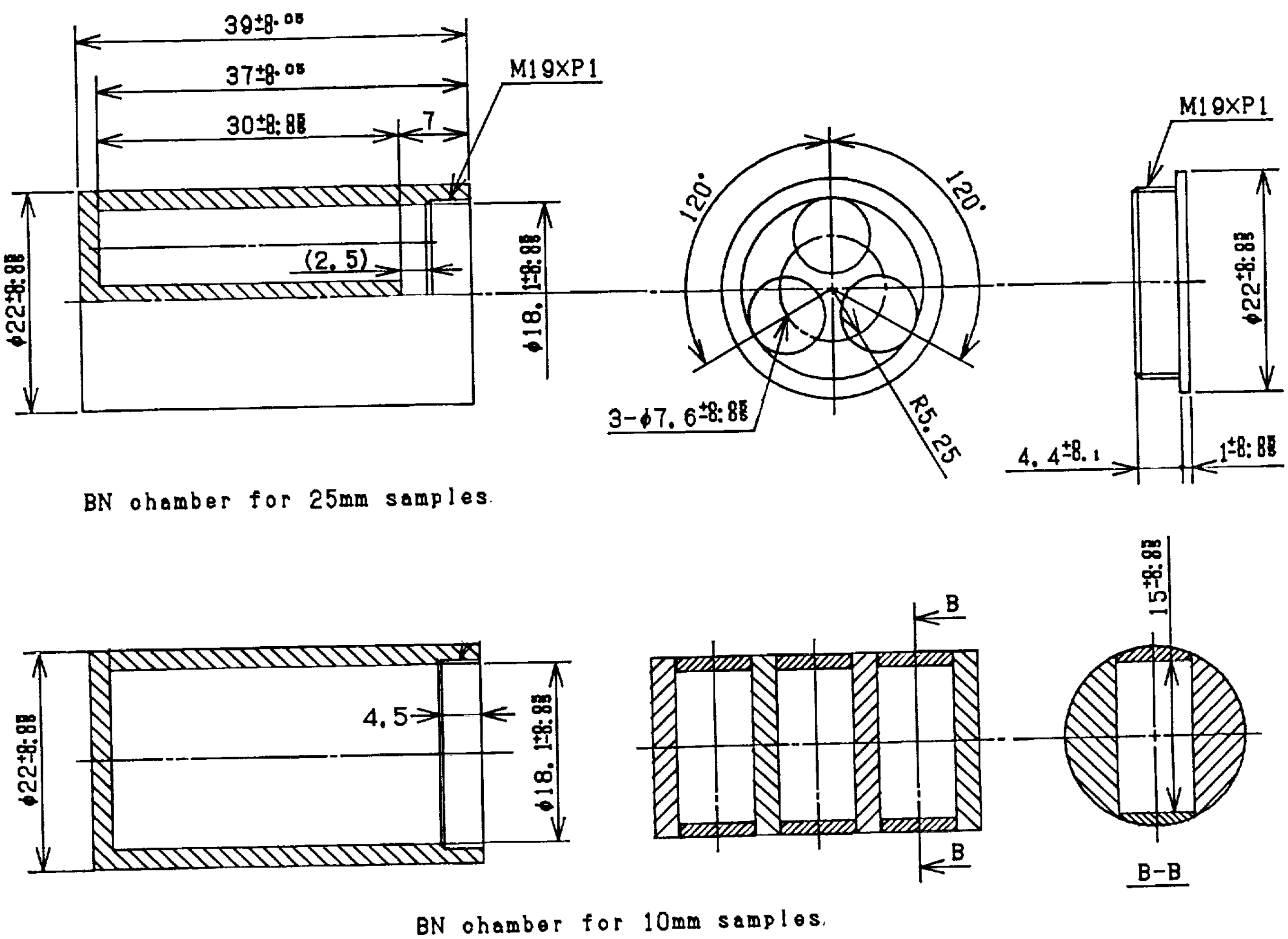

Figure 2. BN chambers for 25 mm and 10 mm samples.

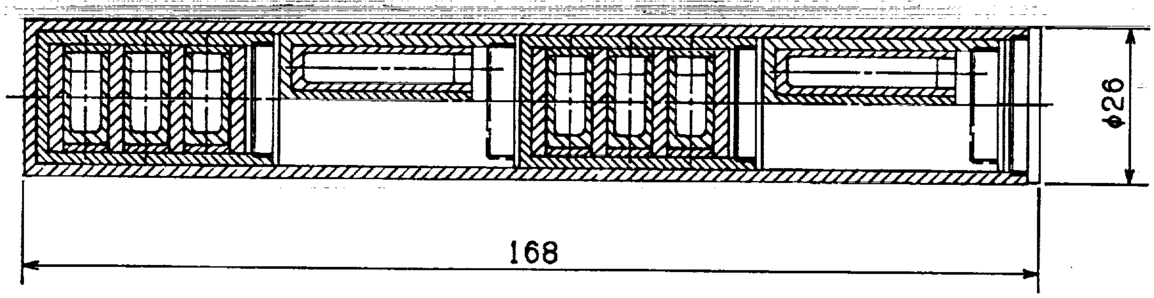

Figure 3. Setup of Al203 crucibles and BN chambers in Mo container.