Electrical evaluation of molten lithium niobate using floating zone furnace

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The electrical evaluations of the molten oxides, from which the crystals were grown, are thought to be powerful tool to investigate the transport phenomenon and interfacial phenomenon between the melt and the crucible material\(^1\). These evaluations were essentially important for growing high quality single crystals. In this paper, the electrical properties of the high temperature LiNbO\(_3\) melts were measured using a modified floating zone furnace. Thermoelectric power due to the temperature difference at the Pt electrodes was clearly observed for the molten LiNbO\(_3\) under various conditions of O\(_2\) concentrations in atmosphere.

In order to measure the electrical properties of the molten LiNbO\(_3\), a floating zone (FZ) furnace has been modified (Fig. 1) (Crystal System Co. Japan)\(^1\). The Pt plates and Pt wires are used as the electrodes. Non-doped congruently melting LiNbO\(_3\) was used as the specimens. Electrical conductivity was measured using Kethley 6517A type electrometer.

The molten LiNbO\(_3\) is suspended by the two Pt electrodes (Fig. 2). The shapes of the melts was observed using CCD camera system attached to the FZ furnace.

The voltage-current (V-I) curve was measured with applying the voltage from about \(-1\) V to 1 V (Fig. 3). Thermo-electric power was estimated from the I-V curves using the bias voltage at current of 0 mA. Similar thermoelectric power is observed in all the LiNbO\(_3\) specimens. The electrical resistivity of molten LiNbO\(_3\) increases with O\(_2\) concentration of the atmosphere.

Reference

Fig. 1. Electrical evaluation equipment of molten LiNbO\(_3\) using floating zone furnace. Electrodes are modifies as shown in Fig. 2.

Fig. 2. Droplet of molten LiNbO\(_3\) supported by Pt electrodes in FZ furnace. Thermocouples are located near the electrodes.

Fig. 3. I-V curve for molten LiNbO\(_3\) droplet at various position in the FZ furnace. Temperature difference between electrodes varies at the position in the furnace.