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MEASUREMENT OF DIELECTRIC LOSS OF ICE Ih AT MICROWAVE FREQUENCIES WITH CAVITY RESONATOR (ABSTRACT)

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The relative complex dielectric permittivity ($\varepsilon^* = \varepsilon' - i\varepsilon''$) of ice Ih was measured at 5 GHz and 10 GHz by the cavity resonator method in the temperature range $-60\,^{\circ}$C to $-3\,^{\circ}$C. The purpose of this study was to clarify the temperature dependence and frequency dependence of dielectric loss ($\tan\delta = \varepsilon''/\varepsilon'$) of ice at microwave frequencies. Because the values of dielectric loss of ice strongly contribute to the penetration depth of microwaves in ice, investigation of the dielectric loss of ice is important for analysis of microwave remote sensing data of the cryosphere. The cavity resonator method is suitable for low loss materials such as ice. Ice samples were polycrystalline and made from distilled and deionized water.

The experimental results were as follows: The values of dielectric loss increased as the temperature increased. The values were $1.0 \sim 2.2 \times 10^{-4}$ at 10 GHz and $0.6 \sim 1.4 \times 10^{-4}$ at 5 GHz in the temperature range $-60\,^{\circ}$C to $-3\,^{\circ}$C. The gradients of dielectric loss versus temperature ($\mathrm{d}\tan\delta/\mathrm{d}T$) also increased as the temperature increased. The values of penetration depth in ice at 5 GHz and 10 GHz were about 80 m and 14 m at $-60\,^{\circ}$C, 35 m and 10 m at $-3\,^{\circ}$C, respectively.

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