Observation of electron temperature and density by Fast Langmuir Probe during SEEK2 campaign

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The sounding rocket experiment, SEEK2, was carried out to investigate a generation process of the ionospheric irregularity in the E region. In this experiment, two sounding rockets were launched to carry out in-situ measurements as well as the ground based radar observations were coordinated to reveal temporally and spatially structure of the irregularity. In this presentation, we will discuss a result of Fast Langmuir Probe (FLP) measurement onboard the first (S-310-31) rocket.

A cylinder probe with diameter of 3mm was attached to the position 41cm from the tip of the rocket in a such a way that it perpendicular to the rocket axle when it deployed. Observation of current voltage curves was carried out by sweeping voltage from 0 to 2.5V with 250msec period. Probe current was amplified by different amps with the gains of Low, Middle and High. Although normal sampling interval was 0.025V (400Hz), it measured at the finer step of 0.0125V(800Hz) in Middle gain to observe more correctly in the altitude of 90 and 120km during the ascending flight. The data during this region was temporary stored on memory, and replayed by using telemeter channel of Middle gain after the time of 193s from launch (after the rocket passed near the top).

Both ascending and descending flight data acquisition was right, and reliable data of electron temperature was obtained without the region that electron density was extremely high.

Main results of our analysis are summarized as follows.

1) Altitude profiles of electron temperature and density are derived by elucidating the current-voltage relation obtained from Langmuir probe. In particular, we successfully estimated the electron temperature and density inside the sporadic E (Es) layer during a descent period of the rocket flight. Thereby, it was found that the electron temperature slightly decreased in comparison with that in the ambient region, while no electron temperature measurements inside the Es layer were successful in the past. These data are essential to discuss the energetics and dynamics of plasma inside the Es layer.

2) Due to unexpected change of the rocket potential, no estimations of the electron temperature were made for the data in the Es layer at the height of 103 km during the ascending flight. However, the maximum ion current can be monitored so that we can identify a clear increase of the ion current inside the Es layer.

3) It is remarkable that the electron temperature locally decreased and the electron density significantly increased at the altitudes of 128 km and 148 km during the ascending flight, which was accompanied by the electric field fluctuation.