Development of Compact Plasma Instrument（TeNeP） for Nano and microsatellite

K. -I. Oyama, C. Z. Cheng, Yu-Wei, Hsue
Plasma and Space Science Center, National Cheng Kung University, Taiwan
oyama@pssc.ncku.edu.tw

Abstract
The satellites for the educational purpose are being manufactured in many Universities in the world. Their weight ranges from several kg to 20 kg. However most of the satellite seems to be engineering oriented. For the scientists, these Nano/micro satellites constellation might provide excellent chances to conduct new sciences and to increase the research opportunities. In order for the science instruments to be accommodated in the Nano/microsatellite, the following factors need to be fulfilled; 1.The small dimension/low power consumption of the instrument, and data bit rate should be very small. 2. The sensor should be easily deployed or fixed without complex mechanism and, 3.The weight of the sensor should be right so that its deployment should not disturb the attitude of the satellite. These requirements are fundamentally important for the instrument to be accommodated in tiny satellites. It goes without saying that even small instrument should have a good performance in addition to provide accurate, and reliable information. Here we developed one plasma instrument to measure both electron temperature and plasma density simultaneously. Frequency sweep circuit is added to the conventional electron temperature probe [1]. The electron temperature probe which was developed more than about 30 years ago was accommodated in 5 earth orbiting satellites as well as Mars orbitor, and about 50 sounding rockets in Japan including the sounding rocket in Antarctica. The probe was used for the sounding rocket experiment in India, Brazil[2], Canada, U.S.A, and West Germany. The probe was also accommodated in Korean, Brazil, and Russian satellites.

The circular electrode (100 mm in diameter, and 1.6 mm in thickness) should be ram direction of the satellite, and it should be about 30 mm away from the satellite wall, to avoid the measurement in the satellite wake and in the sheath. The electronics consists of frequency sweep circuit (200 KHz-10 MHz), amplitude modulation circuit and conventional electron temperature probe. The total weight, and power is about 200 g and 500 mW respectively. The bit rate of 2kbits/sec allows us to calculate electron density from upper hybrid resonance. This amount of bit rate also makes it possible to calculate electron density and temperature from the output signal of the instrument in low frequency (200 KHz), which allows us to compare electron densities both from upper hybrid resonance and from the output signal of the electron temperature probe. The measurement duration is about 1 sec. The instrument can be accommodated in 10 kg satellite, that is, the instrument can be accommodated to all satellite of constellation. One of the research subjects by using satellite constellation is to study the precursor features associated with large earthquakes [3,4,5].

Keyword: Instrument**,** Ionosphere, Nano/Micro satellite,

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