Microwave emission phenomena due to material destruction and its applications to geophysical exploration

Tadashi Takano[1]

[1] ISAS, JAXA

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Ken-ichiro MAKI[2], Eriko SOMA[3], Kentaro ISHII[3], Hiroko OHNISHI[4], Shigeo CHIBA[4], Akira FUJIWARA[1] and Shingo YOSHIDA[5]

[1]ISAS/ JAXA, [2] RIKEN, [3] Tokyo University of Science, [4]University of Tokyo, [5] Earthquake Research Institute/ University of Tokyo

Microwave emission was found when materials were destroyed by a hypervelocity impact or by a static pressure. This paper describes the experimental setup to observe the phenomena, the obtained terms and results, and the method to convert to power. Finally, the possibility to apply the phenomena to geophysical explorations will be discussed.

In the receiving system, special care is required for microwave detection. The signal is first amplified by a low noise amplifier, digitized in a sampling frequency high enough for the observed frequency, and then stored as data. The observed frequency is 22GHz, 2GHz, 300MHz and 1MHz. If the data storage capacity is too small to keep the data for a required observation time, namely at 22GHz and 2GHz, the signal is converted to a lower frequency by a heterodyne receiver and then processed to data.

The impact velocity is 7 km/sec at maximum, and was controlled according to experimental objectives. Target material was selected from metal such as aluminum or iron, ceramic, brick or rubber. In the destruction experiment due to a static pressure, various kinds of rocks were pressed with a compressor. The observed microwave is intermittent pulse in every destruction mode. The width of each pulse is quite narrow: 2 nsec at the highest frequency of 22 GHz. In the rock destruction due to a static pressure, 22 GHz was not detected in most kinds of rocks, but the other frequencies were all observed. As the waveforms thus obtained are almost sinusoidal in shape, we can calibrate the power through the receiving system.

As a result, the average emitted power at 2 GHz is counted to be 2.7x10-5mW and 2.7x10-8mW in the hypervelocity and static pressure experiments, respectively. According to the obtained experimental results, the phenomena is expected to be applied to geophysical explorations in the following fields:

(1) Research of material characteristics: celestial body impacts, material science, space debris issues.

(2) Change of the underground structure: rock crash.

(3) Earthquake detection.