§4. Development of Decontamination Technology Using Atmospheric Pressure Plasma

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The idea of removal of the low ionization potential atoms such as ^{137}Cs from the soil in Fukushima by use of the atmospheric pressure plasma (e.g. He plasma exposure) was proposed. It is expected that the ionic bonds between the soil and Cs are cut due to the collisions by high-speed electrons in plasma. The reason for focusing on the atmospheric pressure plasma, regardless of the type of gas, continuous operation of the outside is desired in the removal work. The advantages of atmospheric pressure glow discharge plasma don't need a vacuum pump and there is little thermal damage to the soil because temperatures of ion and gas are the same as room.

The cylindrical quartz glass tube is 40mm inner diameter, 500mm length, and wearing several copper electrodes from the outside. High-voltage power supply (loge electronic LHV-13AC) is connected to electrodes. DC discharge plasma (Dielectric barrier discharge) is obtained by the device. Soil samples collected at Fukushima were provided from "Environmental Radiation Laboratory of Hiroshima University". The radiation dose of the soil before and after the experiment was measured by Ge detector (Ortec,GMX-30200-P). Spectral lines in plasma was measured by the spectroscope (AVANTES, StarLine AvaSpec 3648) borrowed from NIFS. The images of the plasma discharge were taken by high speed camera HX-3 (Nac Image Technology).

Fig.1 shows the spectra of the typical He plasma in the visible region. Most lines are recognized as He I , however, He II lines appeared slightly. Plasma emission form observed by the high speed camera was pulsed discharge. The soil of 5-10g was strewn thinly into the quartz tube and it was exposed by He plasma. Fig.2 shows the rate of ^{137}Cs dose after plasma exposure. For 5, 10 min the rate was about 98%. For 15 min and 60 min those were both about 85%, however, for 30 min it was ~93%. The difference of these values (i.e. plasma exposure effect) was thought to be the plasma condition; even now the plasma parameters were not determined due to the lack of the measurements. Therefore, the effects of plasma parameters and exposure method to the soil should be understood in the near future.

The possibility of the separation of low ionization potential atoms such as Cs from soil by plasma exposure was shown in this report. It is necessary to study the plasma parameter and exposure method to achieve a higher removal rate.

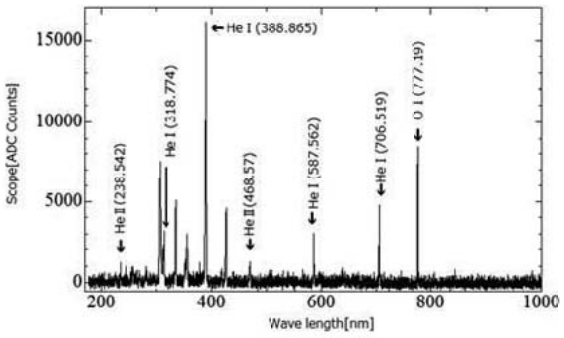

Fig.1 Spectra of He plasma

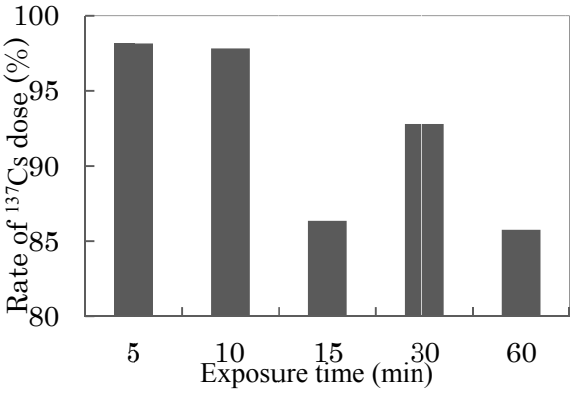

Fig. 2 Dose change rate before and after plasma exposure