Detection of ionized space charge using a photonic-crystal-waveguide module (II)
~Multichannel operation~

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Introduction We challenge to develop the compact space-charge sensors using silicon photonic crystal devices, which can be used in the cosmic space [1-3]. Various charged particles with the high speeds exist in the space. They adversely affect the electronic devices installed in the spacecraft. Serious failures of the satellite caused by the electrostatic discharge have been reported for national projects in Japan. Detailed measurement data for the distribution of space-charges in the cosmic space will be an indispensable piece in the new space age.

We recently reported the space charge detection using the photonic-crystal-waveguide fiber module shown in Fig. 1(a) [4]. When the module was irradiated with the ionized space charges, the output intensity from the fiber module was decreased due to the free carrier absorption by the carrier transferred from the ionized air molecules to silicon photonic crystal. In the future, it is envisioned that several modules will be installed on the surface of spacecraft to detect the charged particles. Here, we report the demonstration of multi-channel operation of the space-charge sensors using four modules.

Experimental Methods and Results Figure 1(b) shows the experimental setup. Excitation light from a super-luminescent diode (SLD) was split to four channels using a fiber splitter and injected into each module. The light intensity of 100 μW, that is irradiated to each module, is sufficient for the sensor. Therefore, only a light source is used. The reason for using the SLD instead of a laser diode (LD) is to stabilize the output intensity from the module [5]. Figure 1(c) shows the results of the irradiation of ionized air to the four modules. Each curve show the time variation of the transmitted light intensity where the ionized air was irradiated from 30 to 32 seconds, indicated in gray. The experimental method is the same as that in the previous report [1]. In all modules, the light intensity decreased immediately after the irradiation and then recovered after the stop of the irradiation, which is the same behavior as previously reported. The above results indicate that space charge detection is possible at multiple locations.

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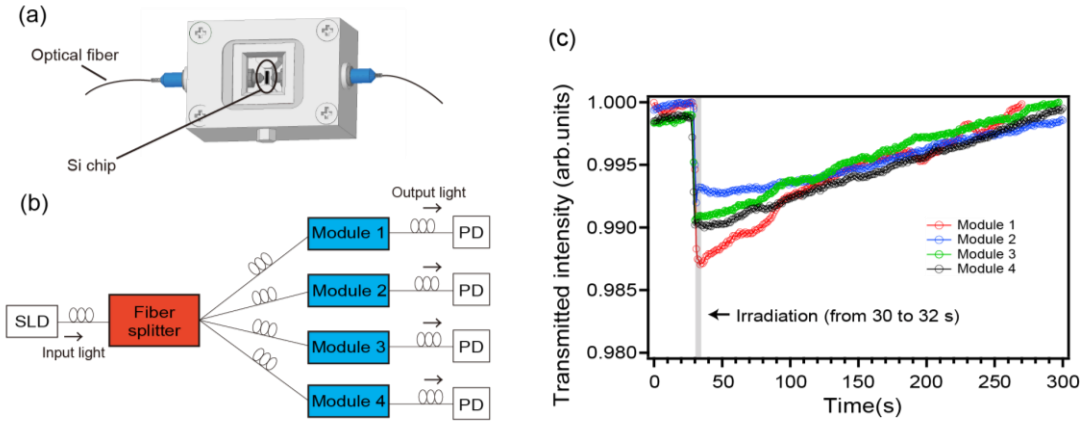

Fig. 1. (a) Photonic-crystal-waveguide module. (b) Experimental setup using four modules. (c) Temporal changes of the intensity of the light transmitted through the modules with the space charge irradiation.