低圧力下で動作可能な色彩センサによるプラズマ発光のその場測定

In-vacuum active color sensor and application to in-situ detection of plasma emissions

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1. Introduction

Plasma diagnostics play crucial roles in monitoring of ongoing processes and characterization of plasma properties. The previous efforts for precise measurements with high resolutions have increased our understandings for these research targets successfully, although we frequently face with difficulties related to large expenses and high technical levels that are required for operations. In the meanwhile, IoT (Internet of Things) technology and big-data handling methods from a huge number of low-cost sensors open new diagnostics in many social areas, but vacuum conditions with exotic natures have prevented IoT sensors from entering internal spaces of low-pressure plasma reactors. In this study, we design an in-vacuum active color sensor for plasma emissions and confirm its validity for a wireless data acquisition system [1].

2. Methods

Details of the experimental setup was in Ref. [1], and here we briefly describe it (see Fig. 1.). This programmable wireless-communication color sensor was composed of a photodiode array, a microcontroller, and a Bluetooth module, packed in metallic casing. We installed it in a quartz glass chamber with 10-cm diameter, in which a capacitive discharge at 100 Pa (Ar) was ignited by 13.56-MHz radiofrequency power to 20 W. We separated the sensor from the plasma region by a metallic mesh, but some plasma particles may sneak into an internal sensor space. A monochromator was set outside the chamber for acquisition of comparative data.

3. Results

The detected signals with red, green, blue and infrared components were successfully transferred to a personal computer outside the chamber. These signals were completely correlated to integral intensities of emission spectra monitored in the monochromator, where a weak emission in the initial ignition phase was also detectable. This fact indicates that the sensor closely located to the low-pressure plasma actively works as a sensor-system component.

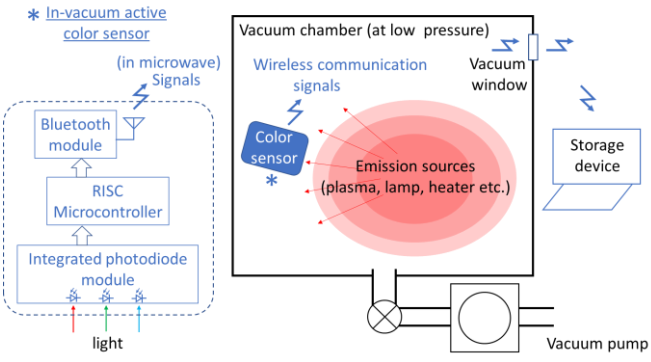

Fig. 1. Schematic view of color sensor system active in vacuum chamber. Reprint from [1] by The Author(s) licensed under CC BY 4.0.

References [1] O. Sakai *et al.*, *Sci. Rep.* **11** (2021) (in press).