Application of micro-arc plasma in highly pressurized sea water

Project Leader
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1. Objective

This project is aimed at:

We have succeeded in generating high-density micro-plasma by micro-arc discharge in seawater that is highly pressurized up to 19 MPa, which is equivalent to 1,900 m deep sea [1-4]. We expect that such micro-arc discharge in high-pressure seawater can be used in the in-situ elemental analysis of seawater under the deep sea by plasma emission spectroscopy and as a new high-intensity white light source.

2. Project Outline

To that end, the project will consist of the following phases:

(a) Development of a gas nozzle for stable operation of a gas jet in a vacuum and in atmospheric air
(b) Development of an electrical power source and an electrode system for stable electrical gas discharge
(c) Investigation of plasma properties and analysis of chemical reaction processes in plasma
(d) Pioneering of novel applications for this technology

3. Expected Performance

In this project, the successful candidate would be expected to:

(a) Work independently when planning, preparing and carrying out the experiments
(b) Report research progress at weekly laboratory meeting
(c) Provide supervision for master and undergraduate students in the laboratory
(d) Perform routine work for the maintenance of experimental apparatus

4. Required Skills and Knowledge

The successful candidate for this project will have the following knowledge and skills:

(a) Basic understanding of physics, chemistry, electromagnetics, electronics and electrical engineering
(b) Principles of gas discharge and plasma science, vacuum systems and engineering
(c) Handling of high-voltage and high-frequency power supplies, electronic measurement instruments
(c) Operation of material analysis equipment such as SEM, EDS, XRD, Raman, FT-IR, XPS, and so on.

References

1) Vladislav Gamaleev, Jun-Seok Oh, Hiroshi Furuta, Akimitsu Hatta: "Investigation of Effect of Needle Electrode Configuration on Microplasma Discharge Process in Sea Water", IEEE Transaction on Plasma Science 45 (2017) 754-760. 10.1109/TPS.2017.2669199
2) Vladislav Gamaleev, Hiroshi Furuta, and Akimitsu Hatta: "Detection of metal contaminants in seawater by spectral analysis of microarc discharge", Jpn. J. Appl. Phys., 57 (2018) 0102B8-1-5. https://doi.org/10.7567/JJAP.57.0102B8
3) Vladislav Gamaleev, Hiroshi Furuta, and Akimitsu Hatta: "Generation of micro-arc discharge plasma in highly pressurized seawater", Appl. Phys. Lett., 113 (2018) 214102-1-5.
4) Vladislav Gamaleev, Hiroshi Furuta, and Akimitsu Hatta: "Atomic Emission Spectroscopy of Microarc Discharge in Sea Water for On-Site Detection of Metals", IEEE Trans. Plasma Sci., 47(4), (2019) 1841-1850. DOI 10.1109/TPS.2019.2901301

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