

# Internship Report

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## 1. Overview

Company: Panasonic Corporation

Receptionist:

Human Resources Department: Imanaka Tsuyoshi

Accepting Department: Naito Hiroyuki

Supervisor: Tamaki Hiromasa

Period: February 23<sup>th</sup>, 2019 ~ April 4<sup>th</sup>, 2019

**Motivation:** I wanted to experience the material development in Panasonic's institute through this intern because I wanted to know what kind of object the thermoelectric materials were studied in the research institute of the company that had to consider the commercialization of the materials. Furthermore, I would like to get a vision when engaging in material development in a company after obtaining a PhD.

### **Background:**

Thermoelectric Material: Thermoelectric materials are functional semiconductor materials that can directly convert temperature difference and potential difference to each other, and are expected to create clean energy and improve thermal efficiency by utilizing waste heat. In fact, there is an example that they have been put to practical use for waste heat utilization in factories. However, for household use, while the use of waste heat from automobiles is expected, development of materials and devices capable of clearing power generation efficiency, raw material cost, raw material toxicity, mechanical vulnerability, etc. are still difficult. Therefore, they have not reached citizenship as a clean energy device like a photovoltaic cell yet.

Materials R&D at Panasonic: Panasonic has succeeded in improving the performance of n-type of  $Mg_3Sb_2$ , for which only p-type has been reported until then, by optimizing the preparation composition and dopant and synthesis method based on first-principles calculations and experimental findings. This material has performance that partially exceeds  $Bi_2Te_3$  and  $PbTe$  that have been put into practical use, and is mainly composed of inexpensive and low toxic elements, and is expected to lead to the development of consumer products.

## 2. Theme and Result

**Theme :** Acquisition of material synthesis methods and evaluation techniques through the development of new thermoelectric materials

The theme for the recruitment was the above, but considering my own research on thermoelectric materials and material informatics in my laboratory, we proposed the new theme; "Synthesis informatics through paper data mining and experiments."

Recently, materials informatics is actively studied in the field of functional materials. However,

even if the accuracy of material property prediction is increased, there is still a gap in actual material development where the material is synthesized and measured. Therefore, synthetic informatics has been proposed for the purpose of predicting material synthesis methods from data science and further improving the efficiency of materials development. The success of synthetic informatics in thermoelectric materials development, in which materials informatics is actively studied, is considered to have a great impact on the materials development field.

**Results :**

In this internship, we have developed a proposal that proposes optimal synthesis conditions of materials by collecting synthetic condition data of papers and performing machine learning. For high-performance materials jointly predicted by Panasonic's material informatics group and the thermoelectric group, it was



confirmed that the experimental method was determined using this proposal, and synthesis and evaluation were actually performed to show good properties.

**3. Impressions**

What I felt most strongly during the internship was that even the company that has succeeded in developing high-performance materials has a long way to go to commercialization. The thermoelectric generation module is basically a product for BtoB trading, so it is necessary for other companies to appeal its usefulness and to realize the required specifications. Especially for the former, I felt that the opportunity for marketing and the lack of human resources made it difficult to commercialize.

There are work environments such as career formation and welfare programs that are important to work in a company. It was a valuable opportunity to be able to hear various stories from many people. About the former I feel that it is an environment where I can keep high motivation as a researcher because they can change the position between researcher and product development as well as change the theme in the research institute and also have abundant overseas experience.

**4. Acknowledgements**

I am very grateful to Panasonic Corporation, the host company of this internship, for taking on an irregular long-term internship at the same time as the short-term one. We would like to thank everyone at the Technology Innovation Center for their support and cooperation to many people in various fields, such as research theme proposals, experimental and informatics support, and intern life. Also, I would like to thank Prof. Kaoru Kimura and Prof. Atsuo Yamada, who is an assistant supervisor of MERIT, for their generous acceptance of the long-term internship. Coordination with companies in this activity was supported by the GMSI program of the Graduate School of Engineering. I would also like to thank the MERIT program for giving me the valuable opportunity of a long-term internship.