MERIT Internship Program (Domestic) Report

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4th generation student of MERIT course

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Abstract

I worked at Amagasaki Research and Development Center of Nippon Steel & Sumitomo Metal Co. (NSSMC), Ltd., from September 13 to November 2, located at Amagasaki, Hyogo, Japan. This internship was performed toward "efficient search for suitable brazing materials for ceramics/metal joining based on machine learning". As results of this research, I succeeded in predicting an suitable material for brazing from about 20,000 brazing materials based on about 20 times first-principles calculations and machine learning. Experience in NSSMC for two months is a very valuable for me to design my career path after obtaining Ph.D.

Activities

Brazing materials, which are generally alloy, are used as an adhesive for brazing. Large difference of the thermal expansion coefficients between jointed materials, such as metal and ceramics, creates thermal stress at a joint, which decreases strength of the joining. A purpose of this research is to efficiently find a suitable brazing material for joining between ceramics and metal based on machine learning. In this study, I searched suitable brazing materials from about 20,000 kinds of copper brazing materials for joining between ceramics and metal based on machine learning (Gauss process regression and Kriging method). As results, I succeeded in finding a suitable brazing material by about 20 times first-principles calculations of the thermal expansion coefficient. Currently, in order to

Figure: Brazing material suitable for ceramics/metal joining found in this research.

confirm whether the brazing material (Figure), which was found in this study, has the thermal expansion coefficient predicted by my calculations, measurement of the thermal expansion coefficient of the brazing material has been carried out.

I observed analysis equipments, alloy casting, and visited steel works. Power of converters, which I saw in the steel works, gave me a realization of new interest of steel industry. In addition, I discussed laser joining of iron-aluminum with a researcher of NSSMC.

Overview

From the internship in NSSMC for 2 months, I was able to recognize commonalities and differences between researches in universities and in a company. What was especially impressed is that, in NSSMC, many researchers are closely working with each other. I recognized power of the research in NSSMC, which is generated from high organizing power based on wide knowledge of researchers. In addition, questions, such as "effects of machine learning on steel industry?" and "means of differentiation from other companies?", gave me a realization of necessary view points for researchers in companies. Through these experiences, I was aware of my shortage skill for work in companies and got guidelines to improve it. These activities are valuable for me to design my career path after obtaining Ph.D.

Acknowledgement