アルバータ大学（カナダ）　研修報告書
ホットワイヤ半導体レーザ溶接技術開発

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1. はじめに

From 16 September to 3 October 2023, collaborative research was conducted at university of Alberta, Canada. The purpose of this research is to expand capabilities for studying and improving the research.

2. 研修/共同研究課題の決定

This research focuses on a tailored overlaying process that uses a diode laser process to perform surface hardening, also widely known as the laser cladding process. This process involves adding material to the workpiece surface to enhance its resistivity. This collaborative research conducted at the Canadian Centre for Welding and Joining, which is part of the University of Alberta, specializes in the laser cladding process and can provide abundant research for Alberta industries, especially the oil and gas industry, which is the largest industry in Alberta.

3. 研修/共同研究スケジュール

16 September 2023	Departure from Hiroshima
18 September - 2 October 2023	Research/Factory visit
3 October 2023	Arrive in Hiroshima

4. 研修先/共同研究派遣先の概要

University: University of Alberta
Location: Edmonton, Alberta, Canada
Advisor: Professor Patricio F. Mendez

5. 研修/共同研究の内容

5.1 Outline

The laser cladding process has been developed for use in many industries. In the oil and gas industry, the laser cladding process is used to modify surfaces to improve wear and corrosion resistance or for thickness repairs on workpieces. This study includes a review of the fundamentals of laser cladding with powder coaxial feeding. Tungsten carbide was chosen as the feed material because of its high hardness and durability.

Many components are used in the oil and gas industry, such as drilling equipment, stabilizers, and wear bands that come into direct contact with the environment. Consequently, corrosion issues occur on these components, leading to a reduction in their working life and performance. These components are utilized in drilling, exploration, and extraction within the oil and gas industry. Reducing of components performance could lead to the decreased productivity and significant financial losses.

Therefore, this research focuses on the coaxial powder feeding laser cladding process, which is widely used to enhance wear resistance. Tungsten carbide powder was chosen for cladding on the substrate due to its properties.

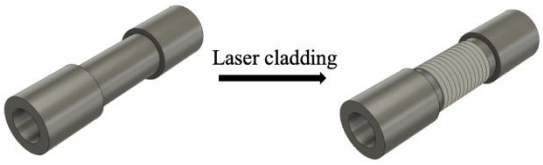

Fig.1 Work piece before and after laser cladding process.

5.2 Experiment

In this study, a coaxial powder feeding system was employed to deposit material into the weld pool, while a diode laser was used to heat the substrate. A 6-axis robot was responsible for moving the laser head to carry out the laser cladding process. Fig.2 displays the equipment schematics, illustrating how the 6-axis robot is used to control the motion of the laser head and the powder feeder connected to it. A high-power diode laser is utilized to create a cladding layer on the substrate, while simultaneously feeding powder onto this cladding layer to allow it to solidify, as depicted in Fig.3(b) and Fig.3(b) shows the actual powder feeding from nozzle head. Once the powder has been fed onto the welded substrate. it solidifies, resulting in the formation of three cladding layers as shown in Fig.4

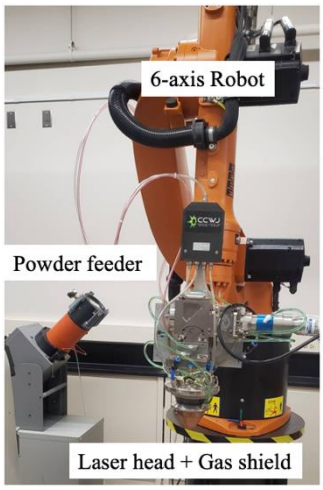

Fig.2 experiment Equipment.

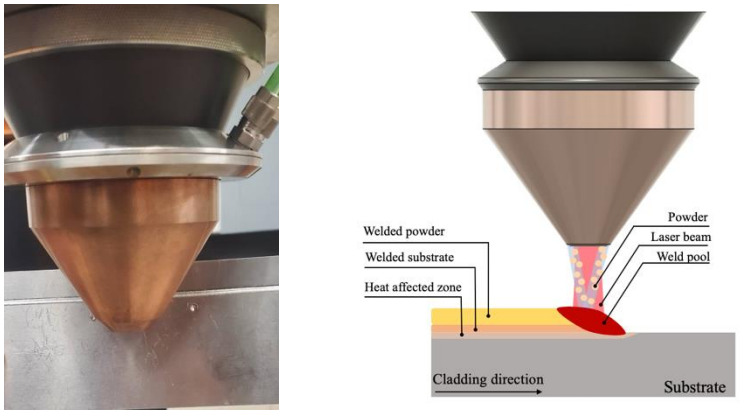

Fig.3 (a)Powder feeding (b) Schematics of coaxial powder feeding laser cladding.

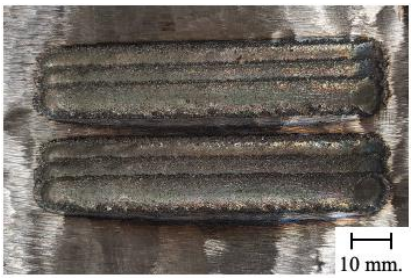

Fig.4 Weld bead

5.3 Discussion

Recently, the laser cladding process has been developed for use in very high-performance applications, achieving a catchment efficiency that can reach up to 90%. Catchment efficiency directly affects cost efficiency, as higher adherence of powder to the molten surface results in greater efficiency. In the future, an increase in high power input will be pursued to enhance productivity in the manufacturing process.

6. まとめ

It has only been 2 weeks, but I have already learned many things in Canada. I have had the opportunity to participate in university classes and experience a different environment. Additionally, having discussions with other students about research and knowledge in my field has been valuable. Moreover, I have also had the opportunity to visit leading companies that are at the forefront of laser cladding processes, which has allowed me to expand and explore my knowledge in this industry. I will continue to improve the knowledge and skills I have gained from this opportunity.

7. 謝辞

I would like to express my gratitude to Professor Patricio F. Mendez for providing valuable experiences, not only in the laboratory but also during company visits, which helped me learn and expand my knowledge in actual industrial work. I am also thankful to Dr. Goetz Dapp for his assistance, from the immigration process to my journey back home. Additionally, I would like to thank Professor Yamamoto Motomichi for providing me with the opportunity to explore abroad. I would also like to acknowledge the Faculty of Engineering, especially student support office of graduate school of advanced science and engineering, for dedicating their precious time to assist and provide essential information, which contributed to the successful completion of this collaborative research.