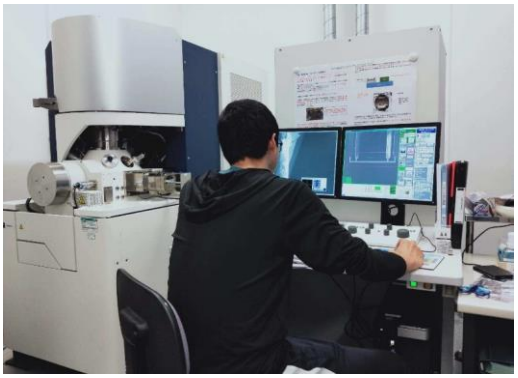
受入大学名	東京大学		
Host University	The University of Tokyo		
外国人研究者	代　俊		
Foreign Researcher	DAI JUN		
受入研究者	割澤　伸一	職名	教授
Research Advisor	WARISAWA Shinichi	Position	Professor
受入学部/研究科	新領域創成科学研究科		
Faculty/Department	Graduate School of Frontier Sciences		

＜外国人研究者プロフィール/Profile＞

国　籍	中国
Nationality	CHINA
所属機関	北京理工大学
Affiliation	Beijing Insititue of Technology
現在の職名	准教授
Position	Associate Professor
研究期間	2019年07月15日　～2019年09月24日　（72日間）
Period of Stay	72 days (Jul. 15, 2019 - Sep. 24, 2019)
専攻分野	機械工学
Major Field	Mechanical Engineering



実験写真

＜外国人研究者からの報告/Foreign Researcher Report＞

①研究課題 / Theme of Research

Superconducting Josephson junction is a very important component for superconducting circuits to function as superconducting devices, as Josephson junction can be used to transfer magnetic signal into readable electrical signal. Since the coherence length of Focused-ion-beam chemical vapour deposition (FIB-CVD) based superconducting W-C material is around 6 nm, it is very difficult to fabricate superconductor-insulator-superconductor (SIS) Josephson junction with the insulating gap of less than 6 nm. Instead, superconductor-metal-superconductor (SNS) Josephson junction with coherence length around several hundreds of nanometer is possible to be fabricated by using FIB-CVD.In this work, we plan to fabricate SNS Josephson junction by using FIB-CVD.

②研究概要 / Outline of Research

First, an electron beam lithography based four electrodes was fabricated. PMMA was used as the resist. Electron beam current of 100 pA was used to write the micro electrodes with width of 500 nm. Electron beam current of 6 nA was used to fabricate the bonding pad. Au/Cr (200nm/20nm) was evaporated and lift off to form the electrode. Then, W-C SNS Josephson junction was deposited by a SMI2050 (SII NanoTechnology) system with a base pressure of 1.0*10-4 Pa. The precursor W(CO)6 with pressure of 3.2*10-3 Pa during deposition) with Ga ion beam current of 5 pA was used to deposit the superconducting W-C wire. Finally, the ion beam current of 1 pA was used to etch the W-C nanowire and form the weak link.

③研究成果 / Results of Research

The four micro electrodes with width around 500 nm were fabricated with electron beam lithography-based technology. An W-C Pt W-C SNS Josephson junction with a geometry of 0.05 mm* 3 mm Furthermore, a Dayem bridge type SNS josephson junction with a geometry of f f40 nm*160 nm was successfully fabricated. The room temperature resistance of these junctions is around 200~400 ohm, which has great potential to Josephson junction behaviour at low temperatures.

④今後の計画 / Further Research Plan

The Voltage-Current (V-I) characteristic of these junctions is planned to be measured at Aoyama Gakuyin University with temperature down to 3.5 K. Transmission electron microscopy (TEM) analysis of these junctions is also planned to be conducted. After analyzing all these results, a manuscript is planned to be written after discussion with Prof. Warisawa.

＜受入研究者からの報告/Research Advisor Report＞

①研究課題 / Theme of Research

Superconducting Josephson junction is a very important component for superconducting circuits to function as superconducting devices, as Josephson junction can be used to transfer magnetic signal into readable electrical signal. Since the coherence length of Focused-ion-beam chemical vapour deposition (FIB-CVD) based superconducting W-C material is around 6 nm, it is very difficult to fabricate superconductor-insulator-superconductor (SIS) Josephson junction with the insulating gap of less than 6 nm. Instead, superconductor-metal-superconductor (SNS) Josephson junction with coherence length around several hundreds of nanometer is possible to be fabricated by using FIB-CVD.In this work, we plan to fabricate SNS Josephson junction by using FIB-CVD.

②研究指導概要 / Outline of Research

I discussed with Dr. Jun Dai and planned the experiment in our lab. First, an electron beam lithography based four electrodes was fabricated. PMMA was used as the resist. Electron beam current of 100 pA was used to write the micro electrodes with width of 500 nm. Electron beam current of 6 nA was used to fabricate the bonding pad. Au/Cr (200nm/20nm) was evaporated and lift off to form the electrode. Then, W-C SNS Josephson junction was deposited by a SMI2050 (SII NanoTechnology) system with a base pressure of 1.0*10-4 Pa. The precursor W(CO)6 with pressure of 3.2*10-3 Pa during deposition) with Ga ion beam current of 5 pA was used to deposit the superconducting W-C wire. Finally, the ion beam current of 1 pA was used to etch the W-C nanowire and form the weak link.

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④留学生交流事業の活動状況 / Activities of International Student Exchange Program

Dr. Jun Dai delivered a lecture in our laboratory meeting when he just came to the University of Tokyo. After that, we had an conversation on the research topic and made a plan about the research theme. Then, he started his experiment at our laboratory using electron beam lithography, focused-ion-beam, evaporation and so forth. Besides the experiments, he also actively communicated with researchers in Japan. He came to Aoyama Gakuin univerisity and discussed with Prof. Sun at Aoyama Gakuin. Also, he had a conversation with Dr. Yamaguchi at NTT-BRL. Furthermore, he used Focused-ion-beam (SMI4050) of Aoyama Gakuin. His student Xu Haoran also comes to ourl lab as an internship student.

⑤今後の計画 / Further Research Plan

The Voltage-Current (V-I) characteristic of these junctions is planned to be measured at Aoyama Gakuyin University at low temperatures. Transmission electron microscopy (TEM) analysis of these junctions should also be conducted. After that, I will discuss with Dr. Jun Dai again by email and arrange the writing of manuscript.

交流写真

訪問写真