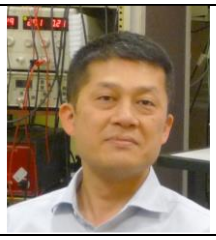
Project report 2020

COSMIC

COmpression-Shearing Method – understanding Interfaces in metal Composites

MAIN PARTICIPANTS

				
Julien FONTAINE[a]	**Hiroyuki MIKI[b]**	**Takamichi MIYAZAKI[c]**	**Matthieu GUIBERT[a]**	**Sho TAKEDA[b]**

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OVERVIEW *(keep within this page)*

Starting year: 2016 **Current researchers** (permanent/non-permanent): 5 person-month/year

Positioning *(Multiple selection allowed – total 100%)*	**Transportation**	**Energy**	**Eng. for Health**
Materials and structure design	5 %	50 %	
Surfaces and interfaces	15 %	30 %	
Simulation and modeling			

Other:

Include partner from ☐ Outside ELyT ☐ Industry

Main funding source(s)
☒ Public project(s) ☐ Industrial ☐ Own resources

IFS CRP/LyC project? ☐ Yes ☒ No

For main projects: Agency / year / name of project *(up to 3, past projects in gray)*

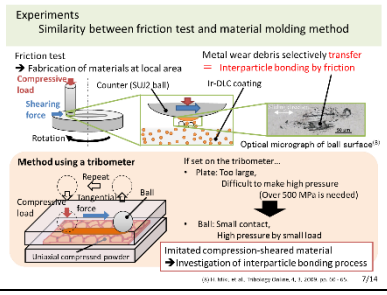
- JSPS, 2019-2022, Grant-in-Aid for Challenging Research
- JSPS, 2015-2020, Grant-in-Aid for Scientific Research
- Frontier Research Institute for Interdisciplinary Sciences, TU/2016-2018/ International Collaborative Research Project

Estimated annual budget: 10,000 EUR

Highlights & Outstanding achievements *(3-5 bullet points)*

- A double degree student (Sho Takeda) took a degree from TU.
- Two publication has been accepted in Tribology Online.
- Project have been partly granted from JSPS.

Illustration *(5x5 cm² max)*



PROJECT DESCRIPTION

Background (10 lines max; Calibri 11)

In recent years, requirements for the material property such as a high strength and/or high toughness are increasing with development of machine and mechanical system. Materials processing is one of the important techniques to improve those properties. Many scientists are working in this field and several processing for manufacturing metal and composite such as casting, and powder metallurgy have been proposed. Our research group has been focusing on a novel powder molding technique, COmpression Shearing MEthod at Room Temperature (COSME-RT) as the method to consolidate metal powder into thin plate directly. In this method, dissolving at high temperature is not required and metal plate can be formed without coarsening of crystal grain and making compound. Consolidated metal plates indicate high mechanical strength according to refined crystal grains.

Key scientific question (2 lines max; Calibri 11)

Development of new molding technique using solid-phase bonding of powder material.
Research on the principle of local solid-phase bonding on metals, etc.

Research method (8 lines max; Calibri 11)

COSME-RT has attracted attention as the novel method of solidifying metal powder. The metal powders are solidified by the enforced plastic flow, and external heating is not required. In this project, the possibility of compacting the metal powder and the composite between metal and other material, polymer, ceramics and compound etc., using COSME-RT will be investigated, to clarify the interparticle bonding of powder particles during the compression and shearing process. With development of this technique, we would like to form the multifunction material which shows the good electrical and friction properties by a simple solidifying process as a practical material.

Research students involved *(gray color for previous years)*

Ph.D. candidates (years, institution):

- Sho Takeda (2015-2018, DD TU-ECL)

Master/Bachelor students (years):

Visits and stays *(gray color for previous years)*

FR to JP (date, duration):

- J. Fontaine (CR CNRS), Stay at IFS (TU, September 2019 (2 days)
- J. Fontaine (CR CNRS), Stay at FRIS (TU, January 2018 (2 days)
- J. Fontaine (CR CNRS), Stay at FRIS (TU, October-November 2017 (1 week)

JP to FR (date, duration):

- H. Miki (Assoc. Prof.), Stay at LTDS (ECL), December 2018 (4 days)
- S. Takeda (DD PhD), Stay at LTDS (ECL), December 2018 (2 weeks)
- S. Takeda (DD PhD), Stay at LTDS (ECL), February-March 2018 (6 weeks)
- H. Miki (Assoc. Prof.), Stay at LTDS (ECL), September 2017 (1 week)
- H. Miki (Assoc. Prof.), Stay at LTDS (ECL), June 2017 (1 week)
- S. Takeda (DD PhD), Stay at LTDS (ECL), April-July 2017 (3 months)
- H. Miki (Assoc. Prof.), Stay at LTDS (ECL), January 2017 (1 week)
- S. Takeda (DD PhD), Stay at LTDS (ECL), January-March 2017 (2 months)

COMMUNICATIONS AND VALORIZATION

Journal publications *(gray color for previous years)*

	Authors	Title	Journal	Vol.	pp. / ID	Year	DOI
1	S. Takeda, H. Miki, J. Fontaine, M. Guibert, H. Takeishi, T. Takagi	Interparticle Bonding of Cu Powder under Repetitive Unidirectional Friction	Tribology Online	13(2)	43-49	2018	doi: 10.2474/trol.13.43
2	S. Takeda, H. Miki, J. Fontaine, H. Takeishi, T. Takagi	Role of MoS_2 Addition in the Consolidation of Metal from Powder to Plate by the Compression Shearing Method at Room Temperature	Tribology Online	13(1)	15-19	2018	doi: 10.2474/trol.13.15

Conferences *(gray color for previous years)*

	Authors	Title	Conference	Date	City	Country	DOI *(if applicable)*
1	Sho TAKEDA, Hiroyuki MIKI, Julien FONTAINE, Matthieu GUIBERT, Hiroyuku TAKEISHI, Toshiyuki TAKAGI	*Transition of Solid-phase Dynamic Alloying Behavior of Powder Particles under Repetitive Tangential Force*	ELyT Workshop 2019	10 March 2019	Osaki	Japan	
2	Sho TAKEDA, Hiroyuki MIKI, Julien FONTAINE, Matthieu GUIBERT, Noboru NAKAYAMA, Hiroyuku TAKEISHI, Toshiyuki TAKAGI	*Solid-phase interparticle bonding of pure cu powder particles under repetitive unidirectional friction experiment*	The 5th Asian Symposium on Materials and Processing (ASMP2018)	7 Dec. 2018	Bangkok	Thailand	
3	S. Takeda, H. Miki, J. Fontaine, M. Guibert, N. Nakayama, H. Takeishi, T. Takagi	*Transition of Dynamic Elasto-plastic Contact Behavior of Pure Cu Powder*	15th International Conference on Flow Dynamics	7-9 Nov. 2018	Sendai	Japan	
4	S. Takeda, H. Miki, J. Fontaine, M. Guibert, T. Miyazaki, T. Takagi	*Mechanism of interparticle bonding of metal powder by repetitive unidirectional friction process, Conference on Material Mechanics*	Conference on Material Mechanics M&M2017	9 Oct. 2017	Sapporo	Japan	
5	S. Takeda, H. Miki, J. Fontaine, M. Guibert, T. Miyazaki, T. Takagi	*Interparticle Bonding of Metal Powder under Repetitive Unidirectional Friction Force*	14th International Conference on Flow Dynamics	1-3 Nov. 2017	Sendai	Japan	