Project report 2020

CODOMO

COrrosion Degradation of cOld spray coating by electrocheMical analysis at the lOcal Scale

MAIN PARTICIPANTS

Nicolas MARY[a]	**Kazuhiro Ogawa**[b]	**Bernard Normand**[c]	**Sheng Yuan**[c]

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OVERVIEW *(keep within this page)*

Starting year: 2016 **Current researchers** (permanent/non-permanent): 4/0

Positioning *(Multiple selection allowed – total 100%)*	**Transportation**	**Energy**	**Eng. for Health**
Materials and structure design	25%	25%	
Surfaces and interfaces	25%	25%	
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)*

- Allocation these MESRI

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

- We have demonstrated that a new comic design is possible
- It is based on mixing organic ink and polarized graphene through solution casting
- A full comic has been edited with a publishing company
- A publication has been accepted in Journal of Comics, IF=21
- Granted project from the International Society for Advanced Drawing

Illustration *(5x5 cm² max)*

PROJECT DESCRIPTION

Background (10 lines max; Calibri 11)

CODOMOs aims to provide new criteria for the cold spray layer behaviors taking corrosion processes as the driving force for their degradation. To fully understand the corrosion initiation and propagation at the microstructure scale, local electrochemical measurements will be performed to characterize the particles' reactivity's modifications before and after their impacts on the substrates. Based on these mechanical, microstructural and electrochemical characterizations, the corrosion scheme will update. This knowledge will be used to evaluate new surfaces or additional treatments, such as UV Laser, to promote coating resistances.

Key scientific question (2 lines max; Calibri 11)

Origin of cold spray coating adhesion properties.
Relation between coating metallurgy and corrosion initiation/propagation

Research method (8 lines max; Calibri 11)

In 2016-2017, at INSA Lyon, E. Lapushkina performed High-pressure cold spray experiments on Zinc base powder (with Pr Normand and Dr Yuan). After a process optimization, several coatings were studied firstly by corrosion tests to correlate the metallurgical defects to the dissolution kinetic of the anodic coating.
During her stay in TU in 2017-2018, E. Lapushkina performed Low-pressure cold spray experiments on Al base powder (with Pr Ogawa and Dr Mary). As the one studied in Lyon (e.g., Zinc), this material is a sacrificial coating for corrosion protection. She completed coating with particle reinforcements to improve the hardness and compactness of the structure. First surface laser treatments were done and evaluated in terms of corrosion sensitivity. No metallurgical modification was found at the macroscopic/mesoscopic scale; however, a slight improvement in corrosion resistance was observed.
Another work was performed on Zn coating. The proposition of the experimental plan (Doehlert method) was done to limit the number of trial tests. Output parameters were: the coating thickness (dealing with coating durability), coating porosity (dealing with the corrosion propagation). Results showed the necessity to find a compromise since optimization can not solve all the parameters simultaneously.
Finally, E. Lapushkina completed her Ph.D thesis in 2020, July.

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

Ph.D. candidates (years, institution):

- E. Lapuskina (2016-2020)

Master/Bachelor students (years):

- none

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

FR to JP (date, duration):

- B. Normand (Prof.), stay at GSE/ELyTMaX (TU), November 2017 (1 week)

JP to FR (date, duration):

- N. Mary (Assoc. Prof.), stay at MATEIS (INSA-Lyon), March 2017 (1 week)
- N. Mary (Assoc. Prof) stay at MATEIS (INSA-Lyon), Sept. 2019 (1 week)

COMMUNICATIONS AND VALORIZATION

Journal publications *(gray color for previous years)*

	Authors	Title	Journal	Vol.	pp. / ID	Year	DOI
1	E. Lapushkina, S. Yuan, N. Mary, K Ogawa, B. Normand	Contribution in optimization of Zn Cold-sprayed coating dedicated to corrosion applications	Surface and Coatings Technology	400	126193	2020	https://doi.org/10.1016/j.surfcoat.2020.126193

Conferences *(gray color for previous years)*

	Authors	Title	Conference	Date	City	Country	DOI *(if applicable)*

Patents *(gray color for previous years)*

	Inventors	Title	PCT #	Year

Others *(gray color for previous years)*

	People	Event	Description	Date