Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Konstantin Makarenko

PhD Program: Mathematics and Mechanics

Title of Thesis: Microstructural, mechanical, and thermal properties evaluation of functionally graded Fe-Cu structures after direct energy deposition

Supervisor: Associate Professor Igor Shishkovsky

Name of the Reviewer: Associate Professor Arkady Shipulin

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Date: 10-09-2023**

The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

Brief evaluation of the thesis quality and overall structure of the dissertation.

The presented Thesis is devoted to the investigation of production of SS 316L – bronze FGMs via the DED and their microstructural, mechanical, and thermal properties. The rate of structure formation and respective parameters were obtained via numerical modelling, as well as optical, and scanning electronic microscopy. The EDX and XRD methods were used to characterize phase and elemental composition of the alloys. Mechanical strength, microhardness, elasticity modulus, yield stress, Poisson's ratio, and other mechanical characteristics were experimentally determined by tensile testing and microhardness measurements.

The dissertation work is fully compliant with the announced topics and relevant to its actual content.

The methods used in dissertation appeared to be adequate and fully relevant to the stated and considered problems.

The scientific significance of the presented work is in the fact, that the microstructural, mechanical, and thermal properties of the laser-deposited Fe-Cu FGMs and quasi-homogeneous materials were successfully investigated for the first time in such a measure. It was found that the difference in final alloy parameters caused by varying operation conditions, chemical composition, are varied significantly. The main findings of this study are described in conclusion of the work. The results are compliant with the current international state of the art.

The findings have a significant importance for achieving porosity-free transition zones with no or small volume fraction of brittle phases for compositionally graded materials and fabricating structures with dissimilar materials. The results of the conducted research can be applied in the aerospace, electronics, NPP, STP, milling, tooling, medicine, defense, and electronic industries.

The obtained in the presented work results have been published in 6 journals, conference proceedings, and one book chapter, which shows a high quality of the results.

I am confident, that the presented work meets the PhD requirements and deserves to be unconditionally accepted for the defense.

Provisional Recommendation

☒ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*

☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report*

☐ *The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense*