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Review Report

on PhD Thesis of Dagmara Malgorzata Fronczek entitled
"MICROSTRUCTURAL AND KINETIC CHARACTERIZATION OF THE PHENOMENA OCCURRING AT THE CLADS' INTERFACES MANUFACTURED BY EXPLOSIVE WELDING"

Supervisor: Assoc. Prof. Joanna Wojewoda-Budka
Assistant supervisor: Dr. Robert Chulist

Dagmara Malgorzata Fronczek submitted the doctoral thesis that deals with lightweight clad systems prepared by explosion welding. The work focuses on microstructure of intermediate layers in as-welded state, after annealing (combination of various temperatures and atmospheres) and after application of external compression.
The work (104 pages) is logically divided into 6 main parts: Introduction, Objectives, Materials and methods, Results, Discussion and Conclusion.

I appreciate a reasonably extensive and well-formulated Introduction to the issue of production of combined materials by explosive welding technology. The chapter is well written, sound and clear. In the work, however, I missing chapter dealing with motivation - for what purpose / applications were these Ti / Al and Mg / Al systems being made.

Part Objectives provides comprehensive overview about the materials studied, the methods of preparation, evaluation and characterization.

Chapter Results (50 pages) summarizes outputs of all relevant measurements and is structured according to the studied materials.

Comparison of results obtained from the characterization of individual materials is in the section Discussion (13 pages). I consider the part of the work sufficient and clear.

The submitted PhD thesis contains 86 pictures, 12 tables and there are 194 references to literature (mostly on articles in scientific journals).

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Remarks to the PhD. thesis:

Page 29: How do you calculated/estimated detonation velocity to be 1900-1950 m/s for the A1050/Ti gr. 2 case?
Page 34: "The simulation with Monte Carlo simulation program 'Casino' indicated that the accelerating voltages of 12 kV and 10 kV induced the material volumes of about 1 μm^3 and 1.2 μm^3, respectively. "
It is probably opposite 12keV probes larger volume than 10keV e^- beam, or?
Page 40: The abbreviation term LAGBs (I assume low angle grain boundaries) is not named and explained in the text
Are you sure the samples were not heat treated by the Explomet company? Is the EXW state really the as-welded state?
In general the XRD data should be treated and interpreted differently than SAED. The 2D XRD patterns should be radial integrated to the diffraction angle (2Theta) intensity (I) and on it the full pattern Rietveld refinement analysis shall be performed. Only good agreement between model and measurement can be considered as proof of assumed phase composition. Such an analysis provides additionally information on microstructure (crystallite size, microstrains) of the phases and their volume fraction. Dagmara will learn the procedure during her stay at the IMR SAS planed in August of this year.

Questions to the PhD. thesis defence:

1. I did not understand whether the creation of a continual intermetallic layer was intended, or you only test high-temperature stability of the interface? Extremely hard >1000HV interlayer may be the place of cracks initiation and propagation, e.g. during a cyclic loading. Was it taken into account?
2. Do you thing the pores like the one on the Fig.44 exist in the as-welded state, or they were just created during the annealing by relaxation of material from internal stresses?
3. What is your explanation; why in the Al/Ti/Al trimetal, page 59, larger amount of cracks were localized in the lower Al layer?
4. What exactly is the relative area fraction of the phase, fig. 63 b? How these percentages were calculated?

The PhD thesis of Dagmara Fronczek fulfils all the requirements foreseen by the Act regarding Scientific Titles and Degrees and thus, I recommend the Scientific Board of the Institute of Metallurgy and Materials Science Polish Academy of Sciences to admit her for public doctoral defence.

Ing. Karel Saksl, DrSc.
vice-director for science