

Response to Reviewer #3's Comments

The authors would like to take this opportunity to sincerely thank the reviewer for his/her valuable comments. We have studied all the comments carefully and have made corresponding corrections that we hope will meet with your approval. The detailed responses to the reviewer's comments are provided below.

The paper "Experimental investigation and optimisation of the semi-solid multi-cavity squeeze casting process for the wrought aluminum alloy scroll" describes prospective technology for obtaining the thin-walled castings using wrought aluminum alloy. Used by the authors technology of squeeze casting may be applied not only to the "classic" aluminum alloys but also for obtaining casting with good structure and properties from metal-matrix aluminum composites (e.g. <https://doi.org/10.1016/j.jmapro.2020.09.067>, <http://dx.doi.org/10.1007/s11665-017-2734-3>, <https://doi.org/10.1016/j.msea.2017.12.091>, etc.). The paper is well written and maybe interesting for the readers. However, some points in the manuscript are questionable and should be modified or described in more details:

1. The applied by the authors technology may be used not only for the alloys. The authors should analyze in the introduction part the application of the squeeze casting technology for the manufacturing of the parts with complex shapes from aluminum metal-matrix composites. This technology significantly increases the wettability of the particles and decreases porosity.

Response: Thanks for pointing out this. The introduction has been revised by adding the advantages of squeeze casting for manufacturing complex components from aluminium metal-matrix composites. Relevant references have also been added. The revised and added content is shown as follows.

This gas and shrinkage porosity can be effectively eliminated by the squeeze casting technology, which has been recommended to manufacture the complex component from aluminum alloys and aluminum metal-matrix composites [12-14].

Please see the revision in liens 47-49 on page 2.

2. The liquidus temperature of the investigated alloy is 615°C. It seems to be strange why the authors have chosen the insulation temperature for the 1 and 2 experiments as 615 and 645 °C, correspondently. At these temperatures, the alloy is out of the semi-solid range and cannot be assessed for the current investigation. The additional explanations should be added to the Materials and Methods part.

Response: Thanks for pointing this out. The temperatures of 615 and 645°C were

designed in Experiments 1 and 2, respectively, in order to compare and analyze the advantages of the semi-solid forming process with the near liquidus and liquid forming process. The revised and added content is shown as follows.

In order to compare and analyze the advantages of the semi-solid forming process compared with near liquidus and liquid forming process, the liquid temperature of 645 °C, the near liquidus temperature of 615 °C, and the semi-solid temperature of 600 and 595 °C were designed in Experiments 1-4, respectively, to study the effect of insulation temperature on the microstructures.

Please see lines 132-136 on page 4 in the revised manuscript.

3. How the authors have recognized the α_1 -(Al) and α_2 -(Al). On the microstructure we see the cross-sections of the different grains. Most of the grains are not crossed at the center and it is hard to separate different types of grains. It is better to remove from the paper two types of the (Al) grains and analyze only the influence of the different technology parameters on the average grain size.

Response: Thanks for the reviewer's comment. Two types of (Al) grains have been removed to better focus on the influence of the operating parameters on the average grain size. Please see the revision in lines 183-184 on page 6, lines 221-222 on page 7, lines 239-243 on page 8, lines 342-343 and 353-354 on page 13, and lines 385-386 on page 15.

4. The main tensile strength property for the constructors is yield stress (YS), but not ultimate strength. The authors should add to the paper analysis of the influence of different technological parameters on the YS. Also, it is recommended for the authors to analyses the influence of the grain size on the YS (for example by using the Hall-Petch relation). It may answer the question is the grain size is the main strengthening effect or maybe others structural parameters also change significantly (dislocation density increases, size of the crystallization origin particles decreases, etc.)

Response: Thanks for the reviewer's comment. We agree with the reviewer that the main tensile strength property for the constructors is yield stress and it is worthy to investigate the influence of operating parameters on the yield stress. However, the product studied in this paper is the scrolls for the scroll compressor. The fracture of the scroll is the general damage form of the scroll compressor, which is mainly caused by the significant impact force generated during the operation. Therefore, the ultimate strength is investigated in this study as it can reflect the difficulty of the break occurrence, which is an important indicator for the quality of the scroll.

Relevant explanations have been added in the revised manuscript, which is shown as

follows.

The fracture of the scroll is the general damage form of the scroll compressor which is mainly caused by the significant impact force generated during the operation. The ultimate strength is investigated in this study as it reflects the difficulty of the break occurrence, which is an important indicator of the scroll quality. Therefore, the mechanical properties investigated in this study contains the tensile strength, elongation, and hardness.

Please see lines 206-210 on page 7.

5. Minor corrections are also required:

- the error ($\pm$) of the properties should be added to the values throughout the article.

The number of the digits in the values of the structure parameters and properties should be decreased accordingly error value (for example, in the Abstract instead of 110.92 μm should be 111 ± 3);

Response: Thanks for the reviewer's comment. The error ($\pm$) has been added to the values in the study and the digits of all numbers have been corrected as suggested. Please see the revision in the revised paper.

- error bars should be added in figures 7 and 10.

Response: Thanks for the reviewer's comment. Error bars have been added in Figures 7 and 10 as suggested. Please see the revision in line 230 on pages 8 and line 298 on page 11.

- information about mechanical test conditions and equipment should be added.

Response: Thanks for the reviewer's comment. Information about the mechanical test conditions and equipment has been added in the revised manuscript. The added information is shown as follows.

Samples from the central region of the scroll (Position A2) were used for testing the mechanical properties by using the universal materials tester (INSTRON 5982) and the hardness tester (HV-1000). For obtaining the tensile strength and elongation, samples were stretched to break at the speed of 2 mm/min. In order to test the hardness, samples were processed under the test load of 200 g with the pressure holding time of 15 s.

Please see the revision in lines 163-167 on page 5.