Review of: "Investigating the Mechanical and Tribological Effects of MoS2 Reinforcement in AZ91 Magnesium Alloy: A Comprehensive Experimental Study"

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Potential competing interests: No potential competing interests to declare.

This paper presents the results of applying the FSP method to the strengthening of AZ91 alloy using MoS2 particles. An interesting approach presented by the authors is making a series of holes in which MoS2 particles were placed, as an alternative to the application of grooves in which the strengthening material was placed. Despite the high potential of the subject matter, I rate the paper low due to a number of research deficiencies that would lend credibility to the results presented in the paper. The shortcomings, which I list below, constitute a significant obstacle to the ability of other researchers to reliably reproduce the experiment, which is the essence of the quality of published scientific papers. However, the biggest criticism of the work is the lack of discussion of the obtained results with any other literature reports on the strengthening of magnesium alloys, whether by other methods or with the use of other additives. Therefore, it is not possible to evaluate and compare whether the approach presented in the paper is better or worse compared to other works and methods. In particular, it would be useful to compare the presented hole reinforcement method with traditional grooving.

The title of the article is very general and does not indicate what properties or processes were studied in the article. In addition, the authors indicate that they will study tribological properties, which were not found in the article.

The authors do not specify whether the material they used for the study was a rolled sheet, a casting, or yet another form. Justification for the choice of MoS2 is also not provided.

While the authors devoted a lot of attention to presenting the properties of MoS2 in the context of its use in electronics, they did not explain how this addition translates into a change in the mechanical properties they studied in the paper - there is no reference to the literature in this regard.

The description of the method of making holes in the material subjected to FSP was not supported by detailed information on the spacing maintained between the holes made.

The authors state in the text that the tool with which the FSP process was carried out had a rectangular shape, while in the photo the tool shows a hexagonal shape. There is no information on how deeply the tool penetrates the sample during the FSP process.

The materials and methods section does not include a description of many important tests whose results the authors later

describe in the next chapter. The authors do not specify what apparatus they used to conduct the tests; for example, hardness measurement, SEM imaging, or tensile testing. In addition, in describing the hardness tests, the authors mention that they used the Brinell method, while later they mention that they determined Vickers hardness. Measurements of the hardness of welded joints (or other materials with heterogeneous structure) are typically presented on a hardness profile, taken linearly and including the pass through the strengthened zone. In this paper, the authors present only 3 hardness measurements from which they calculate the average value, while they do not specify where exactly on the specimen these measurements were made. Much more information could be presented if a hardness profile were made starting in the zone of the native material, passing perpendicularly through the zone strengthened by the FSP process, and exiting and ending the measurement again in the native material. In addition, it would be very interesting to measure the hardness along the performed reinforced zone, especially in the context of the performed reinforcement with MoS2 particles and the degree of their mixing with the native material in the sections between the holes in which these reinforcement particles were placed. This would allow conclusions to be drawn as to whether the spacing between the holes made was chosen correctly, or whether by changing it a more homogeneous consolidation could be achieved.

In the materials and methods section, the authors state one rotational speed at which they conducted their tests, while further on in the paper they present results achieved for 3 different speeds, the values of which do not coincide with those presented in the materials and methods section.

In the text, the authors state that the highest hardness was achieved using 1100 rpm, while the data presented in Table 3 clearly shows that the highest hardnesses were achieved for a rotational speed of 700 rpm.

The authors did not indicate specifically what standard they followed during static tensile testing and what geometry of specimens they adopted for testing (they only give an example ASTM standard, but it is not clear whether they followed it specifically). In addition, they do not provide information on whether the specimens for the strength tests were cut along the reinforced zone or perpendicular to this zone. The text also does not provide information on the number of samples for tensile testing. It would be useful to provide information on how the strain of the specimens was measured during the strength tests, whether an extensometer, video extensometer, or another method was used?

The authors do not provide very important information on how the metallographic preparation was done to observe the microstructure, from where specifically these samples were taken, and which location is shown in the images included in the paper, as well as whether the samples were etched and what reagent was used to etch these samples?

Analyzing the curves of the static tensile test raises the question of why, in the case of each specimen, about 16% strain was achieved without an applied force, and one can even get the impression that the strain was achieved with a decrease in this force. The complex and very complicated shape of the curve achieved for the sample obtained using a processing speed of 1100 rpm requires a thorough analysis and explanation of why it runs so irregularly.

The authors mention in the text the analysis of chemical composition, while such results cannot be found in the paper.

In the conclusion, the authors again state that the traverse speed of the tool was 15 mm/min, while the material and method section reports 20 mm/min. Moreover, in the conclusion, the authors make a very audacious claim of increased wear resistance, unsupported by any evidence or research.

It is incomprehensible to me what the superscript at the beginning of each reference means. For reference no. 9, no detailed bibliographic data, such as volume number, page numbers, year of publication, etc., is provided. In addition, many literature sources are older than 10 years.

The comments presented above do not exhaust all the objections to the reviewed work; they only present the most important drawbacks that affect the low assessment of the work.