Manuscript Number: metals-2305484
Cutting Chatter in Ultrasonic Elliptical Vibration Cutting and Its Influence on Surface Roughness and Tool Wear

Dear Reviewer:

Thanks very much for taking your time to review this manuscript. I really appreciate all your comments and suggestions! Your comments are extremely vital for improving the structure of the paper and optimizing the content of the paper. We will respond to your comments one by one. Please find my itemized responses below and my revisions/corrections in the revised manuscript.

please note:

Text in *italic* style: *the comments.*

Text in regular style: responses to the comments.

Changes were highlighted in blue color in the revised manuscript.

To ensure that every comment is answered, we number all comments one by one.

Good wishes!

All authors

Review 3:

The results presented in the paper are important from the technical point of view, so it could be some added value to the reader. In general the paper is well organised, however, the reviewer has some points which should be taken into consideration to improve the quality of the manuscript.

(1) There are a lot of markings, especially in equations; therefore, in reviewer opinion, the abbreviation section should be added. It will help the reader follow the text, especially when all of abreviations will be in one section. This approach will also help the authors to remember about the units!!!

(2) Pleass clearly explain why those not other cutting parameters were used?

(3) - Why were those parameters of the surface texture analysed, not others? What was the measurement area? What filtration was used? Significant information connected with the measurement process should be added.

(4) - What was thedispersion of the roughness parameters?

(5) - The surface roughness is haracterized by the surface roughness parameters. Therefore, please specify the parameters that were analysed insted of the usage of encryption with the words such us'surface roughness' (Fig. 8).

(6) - Please add the scale to the figures where it is necessary (for example, Fig. 4).

(7) - To Figs. 6 and 7 the scale of colours should be added as well as information from which direction the profiles were extracted from the surface texture; additionally, please add the detailed description of particular subfigures (for each subfigure there are 3 figures – what these Figures mean should be described).

(8) - Definitively the style and language should be improved. The authors should look at the details (for example, what is the the Sa50 on page 7 - it is surface texture parameter and its value, not a one word.!!!)

(1) There are a lot of markings, especially in equations; therefore, in reviewer opinion, the abbreviation section should be added. It will help the reader follow the text, especially when all of abreviations will be in one section. This approach will also help the authors to remember about the units!!!

RE: Thank you very much for your suggestion. According to your opinion, we merged the formulas and put the meaning of the characters together. Modified as follows.

"The motion equation of the horn particle is:

$$\frac{\mathrm{d}^2x}{\mathrm{d}t^2}+2\frac{\gamma}{m}\frac{\mathrm{d}x}{\mathrm{d}t}+\omega_0^2x=f_0\cos 2\pi ft \quad (2)$$

$$\omega_0^2=\frac{k}{m}=\frac{kh}{H} \quad (3)$$

The damping vibration term is:

$$x=S\mathrm{e}^{-\gamma t}\cos(\omega t+\varphi) \quad (4)$$

Into the formula (1) can be obtained:

$$\left[(\omega_0^2-\omega^2)\sin(\omega t-\theta)+2\beta\cos(\omega t-\theta)\right]=h\cos\omega t \quad (5)$$

By comparing the coefficients of $\sin\omega t$ and $\cos\omega t$ can be obtained:

$$\tan\theta=\frac{(\omega^2-\omega_0^2)}{2\beta\omega} \quad (6)$$

$$S=\frac{h}{\sqrt{(\omega^2-\omega_0^2)^2+4\beta^2\omega^2}} \quad (7)$$

$$x=\frac{h}{\sqrt{(\omega^2-\omega_0^2)^2+4\beta^2\omega^2}}\cos\left(\omega t-\frac{\pi}{2}+\arctan\frac{\omega_0^2-\omega^2}{2\beta\omega}\right) \quad (8)$$

Where x is the displacement, H is the force amplitude, and ω is the frequency of the forced force, ω_0 is the natural frequency, m is the mass of the horn, the length of the horn is l, the cross-section is S, and the density is ρ, one end is fixed and the other end is free to move. It is subjected to the combined action of transverse harmonic load Fz, elastic force k, viscous resistance γ and periodic forcing force $h\cos\omega t$."

(2) Pleass clearly explain why those not other cutting parameters were used?

RE: Thank you for your question. Ultrasonic elliptical vibration cutting parameters can be divided into cutting parameters, tool parameters and ultrasonic parameters. The cutting parameters mainly include cutting speed, cutting depth and feed rate. Ultrasonic parameters are mainly ultrasonic frequency, quotient of amplitudes and ultrasonic amplitude. The tool parameters are mainly the rake angle and the back angle of the tool. The manuscript mainly studies the influence of chatter on cutting surface roughness and tool wear. Among the above ultrasonic elliptical vibration cutting parameters, cutting speed, cutting depth, ultrasonic frequency and amplitude ratio

have significant effects on cutting chatter. In this experiment, the ultrasonic elliptical vibration cutting device comes from Tokamori Corporation of Japan. The ratio of ultrasonic frequency to amplitude is constant and there is no way to modify it. Therefore, in this experiment, we can only give up the study of the effect of ultrasonic frequency and amplitude ratio on cutting chatter. The influence of cutting speed and cutting depth on cutting chatter is studied, and the influence of cutting chatter on surface roughness and tool wear is obtained.

(3) *Why were those parameters of the surface texture analysed, not others? What was the measurement area? What filtration was used? Significant information connected with the measurement process should be added.*

RE: Thank you for your question.

Tungsten alloy has broad application prospects in precision components such as the first wall of nuclear fusion device, the target plate of divertor low heat load area, and the crankshaft of racing engine due to its unique material properties. High-quality cutting surface has an important influence on the service performance of tungsten heavy alloy components. Therefore, we study the surface roughness of tungsten alloy cutting.

The measurement area is the cutting surface of tungsten alloy workpiece.

The cutting surface roughness is measured by white light interferometer. According to your suggestion, the measurement related research content is added.

The cutting surface roughness detection equipment is a white light interferometer, which is produced by ZYGO company in the United States, and the model is zegage. A 10-fold lens and confocal mode were used in the detection. The surface roughness testing standard follows the Chinese ISO 25178 standard. The detection site of tungsten heavy alloy cutting surface morphology is shown in Figure 6.

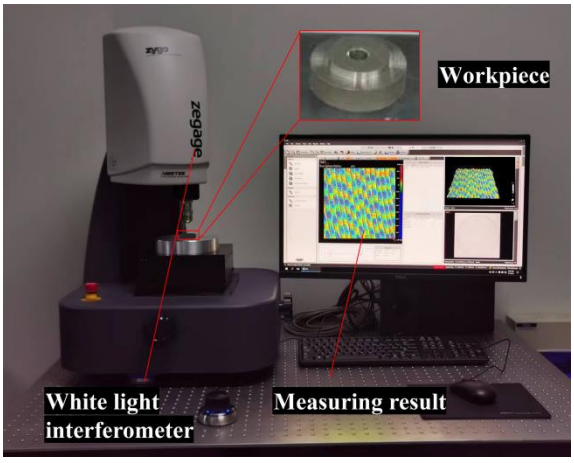


Figure 6. Tungsten heavy alloy cutting surface topography detection site

(4) *What was thedispersion of the roughness parameters?*

RE: Thank you for your question. Due to the small cutting area, the tool is a single crystal diamond tool, and the machine tool is an ultra-precision machine tool. The whole cutting process is very stable. Therefore, the cutting surface roughness consistency is good, and the surface roughness value dispersion is very small, generally less than 5 nm.

(5) The surface roughness is haracterized by the surface roughness parameters. Therefore, please specify the parameters that were analysed insted of the usage of encryption with the words such us'surface roughness' (Fig. 8).

RE: Thank you very much for your suggestion. According to your suggestion, we make the following modifications. Do not know whether our understanding is correct ?

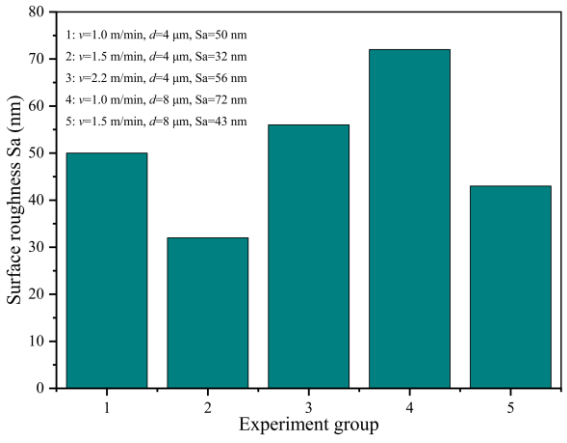


Figure 8. Cutting surface morphology under different cutting depths

(6) Please add the scale to the figures where it is necessary (for example, Fig. 4).

RE: Thank you for your advice. According to your suggestion, the scale is added in Figure 4 and Figure 5.

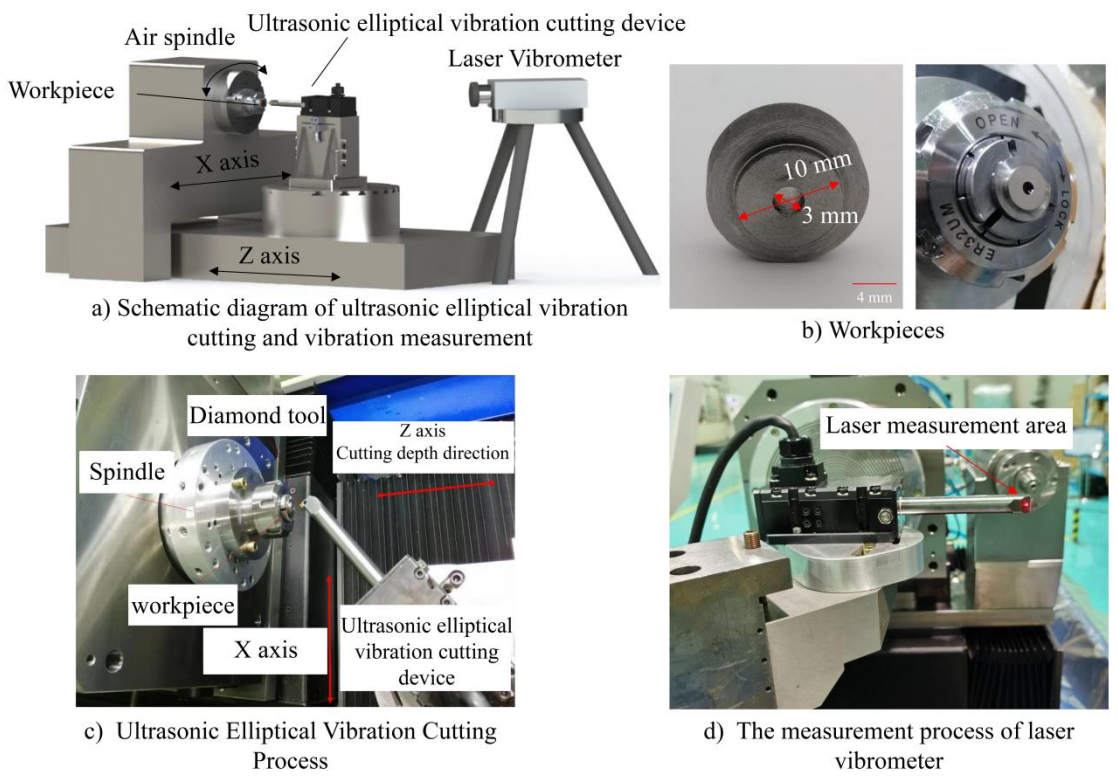


Figure 4. The process of UEVC and laser vibration measurement

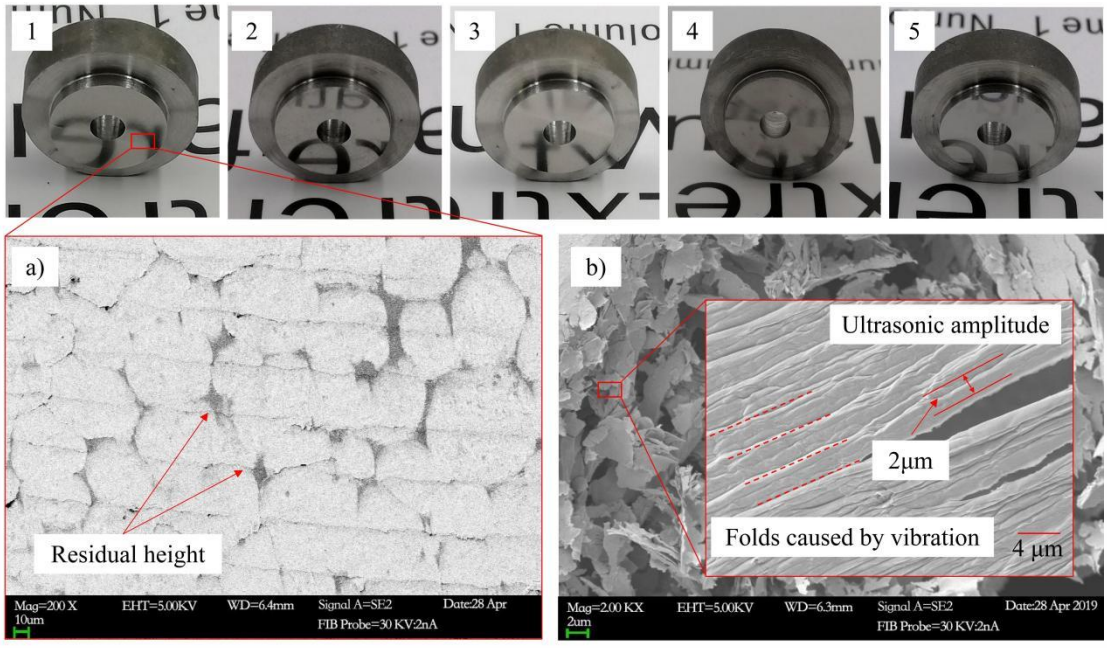


Figure 5. Tungsten alloy cutting surface under different cutting conditions

(7) *To Figs. 6 and 7 the scale of colours should be added as well as information from which direction the profiles were extracted from the surface texture; additionally, please add the detailed description of particular subfigures (for each subfigure there are 3 figures – what these Figures mean should be described).*

RE: Thank you for your guidance. According to your suggestions, we improve the content of Figure 6 and Figure 7. (The original figs. 6 and 7 are changed to fig.s 7 and 8 because a new figure has been added).

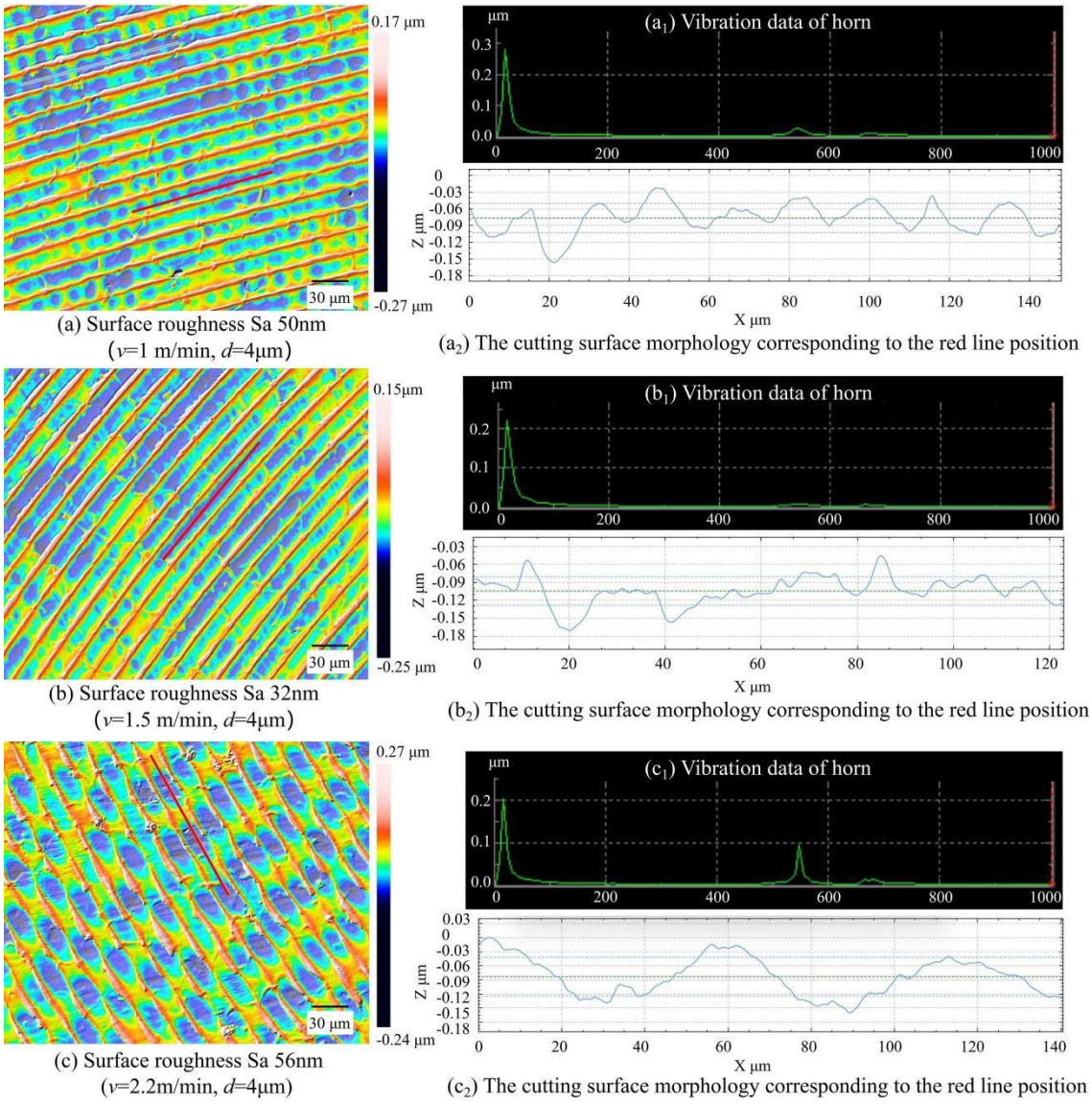


Figure 7. Cutting surface morphology at different cutting speeds

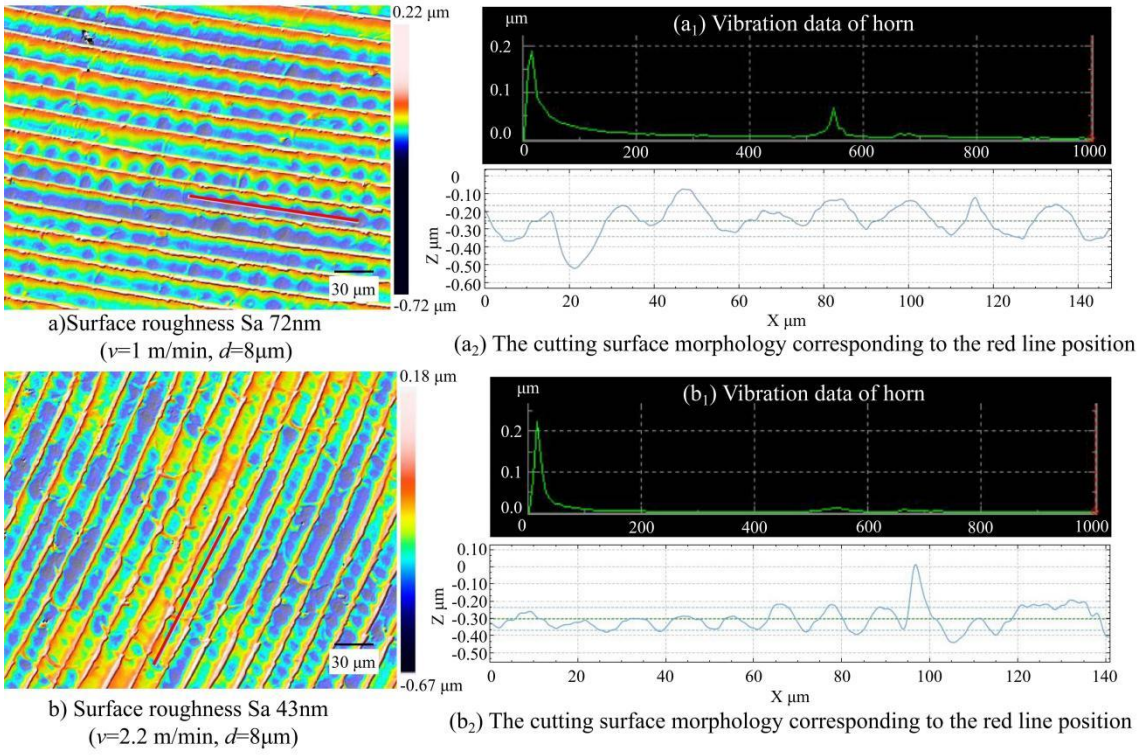


Figure 8. Cutting surface morphology under different cutting depths

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RE: Thank you very much for your reminder, for the full text of the language and format issues, we re-examined and corrected in the revised manuscript.