Dear Dr. Nguyen,

please find below responds to every recommended comment. The responds to the comments have been written in red below each comment. I have tracked all changes in my word processor, however please note that the given line numbers correspond to the document where all changes have been accepted.

Changes to be made by the Author(s):

1. Please take this opportunity to thoroughly proofread the manuscript to ensure that there are no spelling or grammar issues. The JoVE editor will not copy-edit your manuscript and any errors in the submitted revision may be present in the published version.

The manuscript has been carefully proofread.

The manuscript will greatly benefit from copyediting by a native English speaker. There are numerous copy-editing errors throughout.

The manuscript has been copy-edited by a native speaker.

2. In Steps 1&2-please add more detail on how things are connected to each other for the narration.

More details on how the mentioned things are connected to each other have been inserted.

3. Please make sure all references are in the correct format (eg. Ref #4 is not).

[Lastname, F.I., LastName, F.I., LastName, F.I. Article Title. Source. Volume (Issue), FirstPage – LastPage, doi: DOI (YEAR).]

The references have been reviewed and where needed corrected or completed. However, not for all references all issues like page number, doi, etc. where available. Furthermore, some new references have been added due to reviewer’s advices.

Reviewers' comments:

Reviewer #1:

The article provides a very detailed description of a new atmospheric pressure plasma torch and its operation.

Major Concerns:

N/A

Minor Concerns:

N/A

Reviewer #2:

The authors consider and discuss the operation of an atmospheric pressure microwave plasma torch. The research group in Stuttgart is working successfully since many years on microwave plasmas for process technology. Now, they discuss in the submitted paper especially the ignition of such a plasma source.

According to the scope and outline of the journal (JoVE) the authors carefully describe the methods and procedure of their experimental investigations. The recipe-like description of the several steps in the protocol is clear and understandable.

In the following I list some remarks and suggestions for changes / additions:

# The authors state that the coaxial resonator exhibits a high quality (line 108). This statement should be explained in more detail, e.g. the effect of the resonator on the plasma operation and the applications might be extended.

In line 108 to 116 more and detailed information is provided now. Furthermore, in line 146 to 162 this issue is discussed, too.

# The sequence of the figures starts with Fig.3a (line 159). Fig.s 1 and 2 are mentioned later. The sequence should be corrected.

The sequence of the figures has been corrected.

# Concerning the COMSOL Multiphysics simulation (mentioned in line 349) the authors may provide some related references and comparison with MW simulation results of other groups.

In line 379 to 382 references have been inserted. However, a detailed comparison of the presented simulations with results from other groups is not feasibly since different geometries have been used.

# In lines 436 to 439 the authors list the measured gas temperature and electron temperature, respectively, in the plasma source. How did they obtain these values? Please, describe the used diagnostics and data evaluation in more detail.

In line 476 to 481 more information about the method how the temperatures where measured and also reference where they are described in more detail are given. A more detailed description in this JoVE paper would be beyond the scope of the paper.

# Either in the "Introduction" or in the "Discussion" the applications of the MW plasma torch might be discussed more extensively. What are the special purposes of the source the authors studied? In particular, what is the advantage of their findings in regard to the ignition for technological applications?

In line 605 to 622, in the discussion, more information addressing the mentioned issues has been inserted. However, a more detailed discussion about the applications of the plasma source would be beyond the scope of this paper.

Reviewer #3:

Manuscript Summary:

The methods for tuning the double-resonator based atmospheric pressure microwave plasma torch are described in detail so that interested plasma scientists will most probably not face any difficulties to get a similar atmospheric pressure microwave plasma torch in operation without additional igniters. Particularly the video recorded by means of the high speed camera will be of great interest with regard to understanding the single processes from ignition of the plasma in the high-quality coaxial resonator to the plasma finally detaching from the tip of the metallic nozzle. However, it is recommended to the authors to perform some modifications in their paper with regard to English syntax and spelling (see below).

- The title and the abstract are appropriate for this method article.

- The authors provided several examples of application of the atmospheric pressure microwave plasma torch.

- It could not be realized that any major material or equipment would be missing in the table.

- The steps listed in the procedure are described very detailed, so it is expected that the procedure will lead to the described outcome.

- The steps listed in the procedure are clearly explained.

- It does not seem any important step from the procedure missing.

- The authors mention several details that have to be paid particular attention to when reproducing the methods for getting the atmospheric pressure microwave plasma source into operation without any additional igniters.

- The authors revealed all critical steps in detail, so there does not seem any important information missing.

- The anticipated results seem to be reasonable. Consequently, they will be very useful for scientists interested in operation of atmospheric pressure plasma sources without any additional igniters.

- The given references provide a substantial overview on atmospheric pressure plasma sources and their applications and will therefore be very useful for readers.

Major Concerns:

In the paragraph describing the figures 5a) to 5j) (see lines 403 to 427), the cross reference between the text and the figures 5f) to 5j) has to be corrected starting from line 417: [...] The intensity of the plasma grows for the following 692 ms as it is shown in Figure 5[f]). Then, due to the shift of the resonant frequency caused by the burning plasma in the coaxial resonator one millisecond later[,] the plasma starts to break away from the nozzle tip as shown in Figure 5[g]) and 5[h]). The complete break away of the plasma from the nozzle tip is reached after 60 ms as depicte in Figure 5[i]). Now the plasma is burning freely above the metallic nozzle in the cylindrical mode. During the last second[,] the three stub tuner is readjusted to maximize the forward microwave power[...]. This leads to an increase of the plasma as the image in Figure 5[j]) shows. [...]

This has been corrected in line 441 to 464.

Minor Concerns:

I do not have any major concerns with regard to contents. However, the spelling and the syntax have to be significantly improved by the authors.

- Example (lines 301-302): [...] However, it is not necessary to observe the ignition process each time the plasma is ignited by means of a high speed camera. (According to the misleading syntax, it seems that the plasma is ignited by means of a high speed camera. This can be avoided by changing the syntax: [...] However, it is not necessary to observe the ignition process by means of a high speed camera each time the plasma is ignited.)

This has been corrected in line 329 to 330.

- Example (line 520): it should read "[...] the plasma won't ignite [...]" instead of "[...] the plasma wont ignited [...]".

This has been corrected.

- Example (lines 109-110): [...] The plasma is ignited and confined in a microwave transparent [cylinder,] preferably a quartz tube. [...]" (missing word)

This has been corrected.

- Example (lines 100-101): [...] The in this movie presented microwave plasma torch offers the opportunity of an ignition of the plasma solely with the provided microwave power [...] (German syntax instead of English syntax)

This has been corrected.

- The word "slit" can be found several times in the text with wrong spelling "silt" (in lines 343, 431, 444, 447 and 489).

This has been corrected.

- Some words seem to be used in the wrong context, e.g. "color" should most probably read "paint" (see lines 75 and 87), or "supplement[ary]" in the meaning of "surplus" (see lines 70 and 93).

This has been corrected.

- etc.

Additional Comments to Authors:

The authors are kindly asked to have their paper checked by a native English speaker.

The manuscript has been copy-edited by a native speaker.

Reviewer #4:

Manuscript Summary:

In general the topic is clearly presented. Nevertheless, the writing, the numbers and the referencing should be reviewed.

Major Concerns:

Comment 1 (L 114)

The author recommends a low ripple magnetron. Could the author provide any references, how such low ripple tube can be purchased.

In line 127 to 128 a sentence has been inserted, that the magnetron, which used in the JoVE movie, is a low ripple one. The company where this low ripple magnetron can be purchased is given in the table of materials/equipment.

Comment 2 (L 121)

Could the author provide additional references concerning the dependency of the magnetron frequency from the output power.

Sorry, but I found no further literature dealing with this effect. However, we, at our institute, have measured several magnetrons and we observed this phenomenon for all measured magnetrons.

Comment 3 (L 129)

The author should be stricter with using of quality, in means of electrical field amplification, and forwarded power. This subject is well discussed in [1].

1. Rackow, K., et al., Microwave-based characterization of an atmospheric pressure microwave-driven plasma source for surface treatment. Plasma Sources Science & Technology, 2011. 20(3).

In line 142 this has been corrected according to the reviewer’s comments.

Comment 4 (L 294)

To shield the microwave, the mesh size should be much smaller than lambda/half.

In line 322 this has been corrected according to the reviewer’s comments.

Comment 5 (L 384)

The author explains the dip in the S11 parameter by storing of the energy in the resonator. If this is the case, than the field strength should increase over the time. However this field strength inside the cavity should be directly related to the fixed wave amplitude of the incident wave, provided by the network analyzer.

In line 419 to 421 this has been corrected according to the reviewer’s comments.

Minor Concerns:

Comment 6 (L 110)

The author suggests for confining the plasma a quartz tube. However the effect of the tube to the microwave properties of the cavities should be discussed.

In 1189 to 123 more information on this was added and also a reference where this is issue is discussed in detail.

Comment 7 (L 122)

The author starts two following sentences with "the resonant frequency".

This has been changed in line 136 to 137.

Comment 8 (L 139)

The author describes the mode switching of plasma source. It would be interesting how the settings of the three stub tuner, optimized for ignition, influence the power coupling in the cylindrical mode.

More and detailed information on this has been inserted in line 158 – 162.

Comment 9 (L 163)

The directivity of the used directional should be described.

The used directional coupler is a homemade one and no directivity was measured nor needed for this purpose since only the frequency dependence of the measured magnetron is of interest and the value of the microwave power is unimportant.

Comment 10 (L 169)

When measuring with a spectrum analyzer, the used video bandwidth should be mentioned.

More and detailed information on this was inserted in line 404 to 406.

Comment 11 (L 172)

Could the author explain the function of the 20 dB attenuator.

An explanation why this 20 dB attenuator is used was inserted in line 194 to 195.

Comment 12 (L 174)

Concerning the coaxial cable, the author should provide a suggestion for suitable connectors.

Information on this has been inserted in line 197 to 201.

Comment 13 (L 311)

Could the author provide a description of fps.

A description of fps was added in line 340.

Comment 14 (L 343, L 431, L 444)

Is the meaning of used word silt, slit?

This was corrected everywhere in the manuscript.

Comment 15 (L 349)

The author refers to the electric field distribution. However, only the absolute value of it is depicted.

The spatial distribution of the stationary electrical field in the resonator structure is given and not an absolute value.

Comment 16 (L 351)

The author refers to the arbitrary unites of the electrical field. Could the author provide a normalized scale. Furthermore the region around the tip is out of scale.

The simulations were conducted with an older version of the COMSOL Multiphysics software and with the new version the old models cannot be opened any more. Therefore, these pictures cannot be changed anymore.

Comment 17 (L 357)

Could the author review the dimension of the resonator.

The dimensions of the resonators have been corrected in line 3890.

Comment 18 (L 393)

Could the author comment on possible error sources for the discrepancy between measurement and simulation.

More and detailed information on this was inserted in line 429 to 431.

Comment 19 (L 403-427)

The references to figure 5 and the timescale should be reviewed.

The references and the timescales have been corrected in line 440 to 463.

Comment 20 (L 569)

Could the author give a reference for the mentioned tiny little micro microwave plasma jet.

Three additional references have been inserted in line 627.