Detailed Response to the Reviewers

Dear Prof. Tabrizian,

We greatly acknowledge the critical comments of the reviewers which permitted to improve the quality of our manuscript.

Detailed answers to each reviewer comment are given below. Furthermore, all changes are highlighted in yellow in the new version of the manuscript.

Yours sincerely,

Valentin Lang
Response to Reviewer 2

1. Good literature review of interference usage is given in the introduction of the manuscript, however, 3D polymerization by interference lithography is not included, for example, ref. [DOI: 10.2961/jlmn.2016.03.0013]. I recommend include interference lithography into an overview of laser interference applications.  
   Answer: We are grateful to the reviewer for drawing our attention to the work described in the recommended reference. The research achievements described in that paper are undoubtedly significant. However, there are major differences in content to the work here submitted. In contrast to laser interference lithography, where photoresist is used as additional material and irradiated by the laser, in direct laser interference patterning the patterns are produced on the substrate surface by selective ablation and/or melting. However, in order to mention other possibilities to fabricate patterns using interfering beams, the following paragraph has been modified (see page 2 of new manuscript):
   "...While in laser interference lithography a photoresist material is needed for producing the periodic structure, in direct laser interference patterning the patterns are produced on the substrate surface by selective ablation and/or melting [41]."
   The following References have been added to the manuscript:

2. The authors use two beam interference setup with interfering elongated laser beam with THREE cylindrical lenses. Similar setup using only ONE cylindrical lens and one spherical lens described in pioneering work [DOI: 10.2961/jlmn.2010.01.0016]. The much simpler setup gives similar results, therefore, I recommend clarify what is the benefit of usage of the cylindrical telescope on the top of the experimental setup (expansion of the beam in one direction?).  
   Answer: We thank the reviewer for advising us of the significant pioneering work described in the recommended reference. Please, note that we are also utilizing only one cylindrical lens and two prisms. The optical setup presented in our manuscript allows the dimensions of the focus of the interfering laser beams incident on the substrate to be specifically tailored to the requirements of the application, e.g. setting a suitable fluence or fulfilling industrial process specifications. The following text was added to the manuscript regarding to this additional reference in page 2:
   "...A laser interference setup with elongated elliptical laser spots has been also developed by Molotokaite et al. to produce micro-surface patterns on thin metal films deposited on glass substrates [42]."
   The following References have been added to the manuscript:

3. The authors use calculations with includes thermal properties of aluminum (Table 1) for evaluation of thermal diffusivity, however, the number of thermal diffusivity for Al (m^2/s) is missing in the paper, please provide the thermal diffusivity number. The ratio between temperatures in maxima and minima is calculated in work published by Lasagni et al. [DOI: 10.1109/3M-NANO.2012.6473000]. I recommend providing an estimation of the ratio of temperatures in maxima and minima in the current of your work (8-19 um period and 10 ns pulse duration).  
   Answer: The thermal diffusivity is now given in Table 1.
We thank the reviewer for this contribution to enrich the discussion in our work. The following text was added to the manuscript regarding to this additional reference in page 11:

“...The differences between the temperatures at maxima and minima positions has a significant influence on pattern formation, as it has been shown in previous studies by D’Alessandria et el. [54] and Bieda et al. [55]. For instance, temperature differences of 1400 K has been simulated in Aluminum for spatial periods of 7.5 µm with a laser fluence of 1000 mJ·cm⁻² applied [54].”

The following References have been added to the manuscript:


4. The equation numbering is not in sequence (1), (4), (6), (7), (2), (3), (4), (5), etc. Please correct and make equation numbers in sequence like (1), (2), (3)
Answer: This error has been corrected.

5. The melt front movement is shown in Figure 2, also Marangoni convection is mentioned in the text. The thermal capillarity convection (also called Marangoni effect) and its related Plateau-Rayleigh instability in processing using a cylindrical lens can be theoretically evaluated by [http://dx.doi.org/10.1016/j.apsusc.2013.03.092]. The periodical spikes (cylindrical melted ridge formation to periodically arranged droplets) are seen in Figure 2 (a) in the (Y) direction perpendicular to inference periodicity (X) direction. However, no theoretical evaluation of transverse periodicity (Y direction) by physical numbers is given in the manuscript. I recommend include some discussion regarding the periodicity and evaluation of transverse droplet period by measuring the radius of curvature of the ridge (period should follow 9.02*R0, where R0 is the radius of curvature of the molten ridge).
Answer: We thank the reviewer for the literature recommendation, which reveals very interesting approaches about thermal capillarity convection. However, the comparability to the work published by us is very limited for the following reasons. Approaches with self-organizing periodic elements, can achieve suitable surface modifications in certain areas, but differ fundamentally from laser interfering methods. In laser interference structuring, the period is specifically controlled by the angle of the overlapping laser beams. This possibility of active management is a key feature of laser interference technology. Furthermore, the laser source used by us did not provide a Gaussian beam, therefore the results of the proposed reference are not transferable to our work.

6. The measured and calculated by Cassie-Baxter and Wenzel models of contact angles are given in table 2. I would be clearer to see in on the graph how wettability models correspond to experimental data.
Answer: We agree with the reviewer that a representation of the calculated water contact angles in the diagram with the measured values is relevant to improve its comprehensibility. However, the diagram of measured values (Figure 7) already contains a multitude of data points. Since the focus in the diagram (Figure 7) is on the pattern height values, we consider that is better not to include all this information in the same diagram. The
graphs will be less readable by adding further points. The selection of the calculated values was based on systematic criteria and is intentionally shown in a separate listing (Table 2).

7. The parameter "ls" is not declared in equation (4).
   Answer: The description of the variables in the equation has been updated as follows:
   "...According to eq. (2), the pulse overlap is a function of the feed rate \( v_f \), the repetition rate \( f_{rep} \) and the spot size \( l_s \) (in the direction of movement)..."

8. The "Error! Reference source not found" are found in lines 295, 320, etc. Please insert correct hyperlinks.
   Answer: This error has been corrected.