Response to Reviewer 4 Comments

Dear Reviewer,

Thank you very much for carefully review and constructive comments on our manuscript entitled “Tuning the doping ratio and phase transition temperature of VO\(_2\) thin film by dual-target co-sputtering” (Manuscript ID: nanomaterials-490208). We studied the comments carefully and tried our best to revise and improve the manuscript according to your comments. The point to point responses to your comments are listed as following:

**Point 1:** The physical mechanism for reducing the phase transition temperature when doping a VO\(_2\) film with tungsten atoms;

**Response 1:** We have already answered your question in your previous comment as follow: “The reason why doping affects the phase transition temperature of VO\(_2\) crystal has not been uniformly explained by theory. According to the existing theories, the phase transition temperature of VO\(_2\) film reduced by W doping may be due to the substitution of W\(^{6+}\) to V\(^{4+}\) in d orbital. The introduction of excess electrons reduces the band gap of the d orbit and reduces the phase transition temperature, which can be seen in reference [19]. We added the explanation to the related part of the manuscript.” You can see it in our manuscript line 236-line 240.

We’ve also added the explanation for the physical mechanism in the manuscript as “The reason why doping affects the PTT of VO\(_2\) crystal has not been uniformly explained by theory. According to the existing theory, the PTT of VO\(_2\) film is reduced by W doping, which may be due to the substitution of W\(^{6+}\) to V\(^{4+}\) in d orbital. The introduction of excess electrons reduces the band gap of the d orbit and reduces the PTT [19].”

**Point 2:**

Influence of V\(_2\)O\(_5\) on the phase transition temperature. You answer (“… but no one think it will increase the phase transition temperature…” and “Therefore, we can’t draw a conclusion that the existence of V\(_2\)O\(_5\) will increase the phase transition temperature of VO\(_2\) film”) is insufficient. In order to understand my point of view, I would propose you to discuss it answering the following questions:

1) What is the value of the phase transition temperature of V\(_2\)O\(_5\)?

2) What is the value of the phase transition temperature of VO\(_2\)?

3) What can be the value of the phase transition temperature of a 0.95×V\(_2\)O\(_5\) + 0.05×VO\(_2\) solid solution?

4) What can be the value of the phase transition temperature of a solid solution of 0.9×V\(_2\)O\(_5\) + 0.1×VO\(_2\)?
5) What can be the value of the phase transition temperature of a solid solution of $0.85 \times V_2O_5 + 0.15 \times VO_2$?

**Response 2:**

1) The value of the phase transition temperature of $V_2O_5$ is 257°C.\(^1\)\(^,\)\(^2\)

2) The value of the phase transition temperature of $VO_2$ is 68°C.\(^1\)\(^,\)\(^2\)

It is not a solid solution of $VO_2$ and $V_2O_5$ when both $VO_2$ and $V_2O_5$ exist in the film simultaneously. It is only a mixture for them in polycrystalline state. Therefore, the phase transition temperature does not change with the content ratio of $VO_2$ and $V_2O_5$ at all. There are two phase transition temperatures from $VO_2$ and $V_2O_5$ separately. If the existence of $V_2O_5$ will influence the phase transition temperature of the film according to its content, then it should be much higher than the intrinsic phase transition temperature 68°C of $VO_2$ when without doping. However, the result reported by Ma et al. apparently show that the phase transition temperature of $VO_2$ film with $V_2O_5$ is at 67.5°C,\(^3\) which is almost the same as that of $VO_2$'s. This indicates that $V_2O_5$ has no effect on the phase transition temperature of $VO_2$ film at all.


We tried our best to modify and improve the manuscript according to your comments. And we used the “Track Changes” function in Microsoft Word to mark the revision, so that all the changes can be easily noticed by the editors and reviewers.

We appreciate for your constructive and helpful comments on our manuscript, and hope that the correction and response will meet your requirements.