University of Groningen

Response to "Comment on 'Influence of random roughness on cantilever curvature sensitivity'" [Appl. Phys. Lett. 96, 226101, (2010)]

Ergincan, O.; Palasantzas, G.; Kooi, B. J.

Published in:
Applied Physics Letters

DOI:
[10.1063/1.3442494](https://doi.org/10.1063/1.3442494)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2010

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Ergincan, O., Palasantzas, G., & Kooi, B. J. (2010). Response to "Comment on 'Influence of random roughness on cantilever curvature sensitivity'" [Appl. Phys. Lett. 96, 226101, (2010)]. *Applied Physics Letters*, 96(22), [226102]. <https://doi.org/10.1063/1.3442494>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Response to “Comment on ‘Influence of random roughness on cantilever curvature sensitivity’ ” [Appl. Phys. Lett. 96, 226101 (2010)]

O. Ergincan, G. Palasantzas, and B. J. Kooi

Citation: *Appl. Phys. Lett.* **96**, 226102 (2010); doi: 10.1063/1.3442494

View online: <https://doi.org/10.1063/1.3442494>

View Table of Contents: <http://aip.scitation.org/toc/apl/96/22>

Published by the *American Institute of Physics*

Articles you may be interested in

Comment on “Influence of random roughness on cantilever curvature sensitivity” [*Appl. Phys. Lett.* 96, 041912 (2010)]

Applied Physics Letters **96**, 226101 (2010); 10.1063/1.3442493

**THE WORLD'S RESOURCE FOR
VARIABLE TEMPERATURE
SOLID STATE CHARACTERIZATION**

WWW.MMR-TECH.COM

OPTICAL STUDIES SYSTEMS SEEBECK STUDIES SYSTEMS MICROPROBE STATIONS HALL EFFECT STUDY SYSTEMS AND MAGNETS

Response to “Comment on ‘Influence of random roughness on cantilever curvature sensitivity’ ” [Appl. Phys. Lett. 96, 226101 (2010)]

O. Ergincan, G. Palasantzas,^{a)} and B. J. Kooi

Zernike Institute for Advanced Materials, University of Groningen, Nijenborgh 4, 9747 AG Groningen, The Netherlands

(Received 26 April 2010; accepted 11 May 2010; published online 1 June 2010)

[doi:[10.1063/1.3442494](https://doi.org/10.1063/1.3442494)]

In our paper, we state after Eq. (5), page 041912-2 (Ref. 1) that “Fig. 1 shows the cantilever sensitivity T/T_0 as a function of the local slope ρ_{rms} . In fact, Eq. (5) defines a limiting value of the local slope ρ_{rms} for which $T=0$, yielding $\rho_{\text{rms}}|_{\text{max}} = \sqrt{(1-v^L)/v^L}$. For Poisson ratios $v^L=0.18$ [Si(111)] (Ref. 30) and $v^L=0.28$ [Si(100)] (Ref. 30) we obtain, respectively, $\rho_{\text{rms}/\text{max}}=2.13$ and $\rho_{\text{rms}/\text{max}}=1.6$. For a metallic overlayer as gold (widely used to coat cantilevers) with $v^L=0.44$ (Ref. 30) we obtain $\rho_{\text{rms}/\text{max}}=1.12$. These are relatively significant values for ρ_{rms} and the perturbative expansion of Eq. (5) is valid only for local slopes $\rho_{\text{rms}} < 1$”

Therefore as we explain in our paper the validity of the approximate formula is for roughness parameters that lead to local slopes $\rho_{\text{rms}} < 1$. Although in a strict sense we must have $\rho_{\text{rms}} \ll 1$, the expansion in powers of ρ_{rms}^2 multiplied by $v^L/(1-v^L) < 1$ limits the contribution of higher order terms ρ_{rms}^{2n} ($n > 1$) significantly. Around the regime $\rho_{\text{rms}} \sim 1$ (or effectively $\theta \sim 45^\circ$) one has to consider higher order terms in

$\langle \theta^2 \rangle$ in the expansion of the generic Eq. (1) in the comment [or Eq. (2) in Ref. 1]. In any case as stated in our paper, our calculations were performed for local slopes $0 \leq \rho_{\text{rms}} < 1$ corresponding effectively to inclinations $\theta (\approx \tan^{-1} \rho_{\text{rms}}) < 45^\circ$. Moreover, as one can observe from Fig. 1 made from the commenting authors,² for inclinations below $\theta < 45^\circ$ the agreement between Eq. (5) in Ref. 1 and the full calculation shown by the commenting authors² is reasonably good for both Au and Si. Therefore, for inclinations $\theta < 45^\circ$ our analytic formula, as it is shown also by the commenting authors,² is having the correct behavior, while any discussion for angles $\theta > 45^\circ$ is not relevant to our paper since we do not consider this regime. In any case, it came to our attention that due to error in our original publication,¹ Figs. 2 and 3 are not the correct ones and for this reason we have submitted an erratum.

¹O. Ergincan, G. Palasantzas, and B. J. Kooi, *Appl. Phys. Lett.* **96**, 041912 (2010).

²Y. Wang, J. Weissmuller, and H. Duan, *Appl. Phys. Lett.* **96**, 226101 (2010).

^{a)} Author to whom correspondence should be addressed. Electronic mail: g.palasantzas@rug.nl.