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Influence of random roughness on cantilever curvature sensitivity

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

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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).

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