Comment on "Indentation size effect: reality or artefact?"

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In a recently published work of Iost and Bigot [1] the geometrical model of Farges and Degout [2] proposed for the explanation of the indentation size effect (ISE) appearing in Vickers microindentation testing was supported by scanning confocal microscopy (SCM) measurements. The essence of the model of Farges and Degout is that the contact surface between the indenter and the specimen is larger than the surface measured by optical microscope and it causes the increase in the Vickers hardness with decreasing load. According to this model the real contact print consists of the square-shaped impression and the pile-ups with constant width, *f*, near the edges of the indenter. Fig. 1 shows this geometrical model where the shaded zone corresponds to the bulge deformation. Using the corrected contact area in the calculation of the Vickers hardness the ISE can be eliminated.

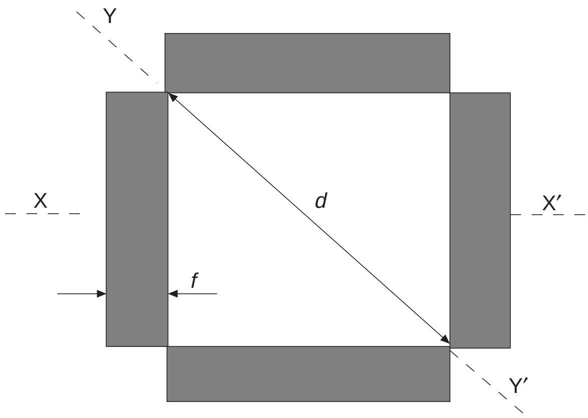

Figure 1 Geometrical model of the bulge deformation.

This model was verified by the SCM surface morphology measurements of Iost and Bigot [1] on titanium and aluminium alloys. They found that the amount of pile-ups at the corners of the Vickers pattern is much lower than those at the edges of the print. They supposed in the calculation of the width, *f*, of the bulging area that the optically measured width of the pattern in the X–X′ direction is smaller than the distance between the top points of the pile-ups at the opposite edges of the impression.

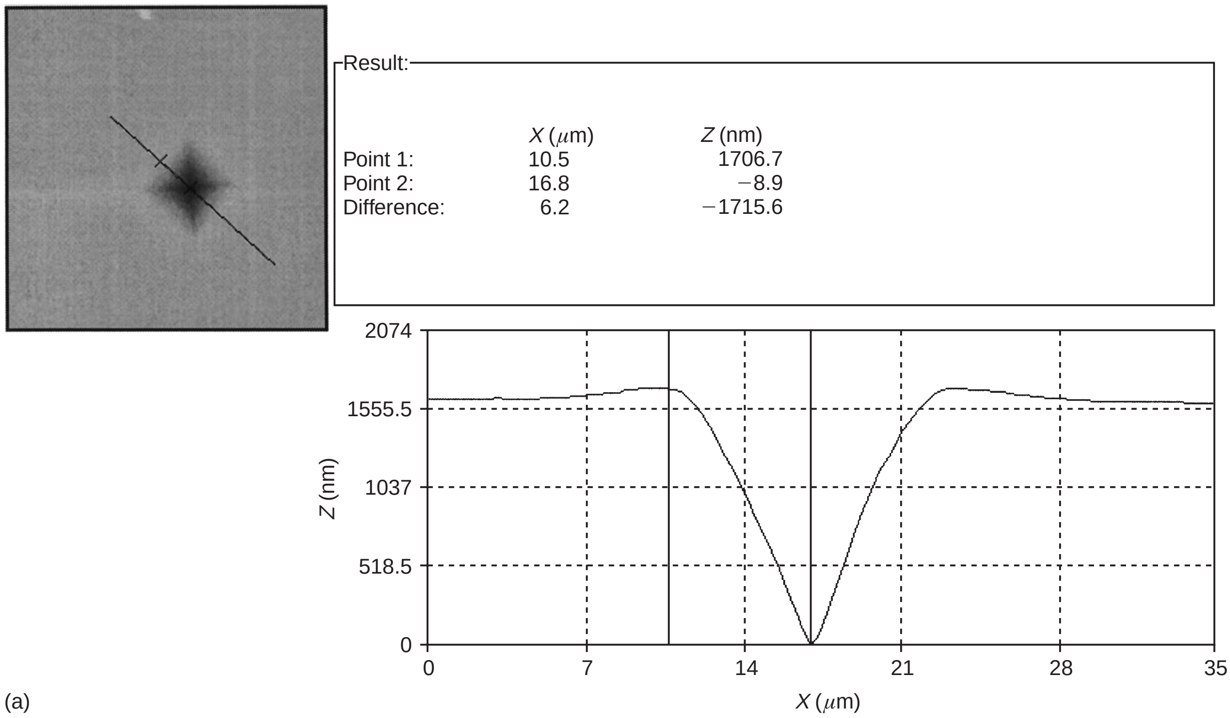

Figure 2 AFM pictures showing the surface profile of the Vickers indentation print ($P = 1.96$ N) in (a) the X–X′ and (b) the Y–Y′ directions.

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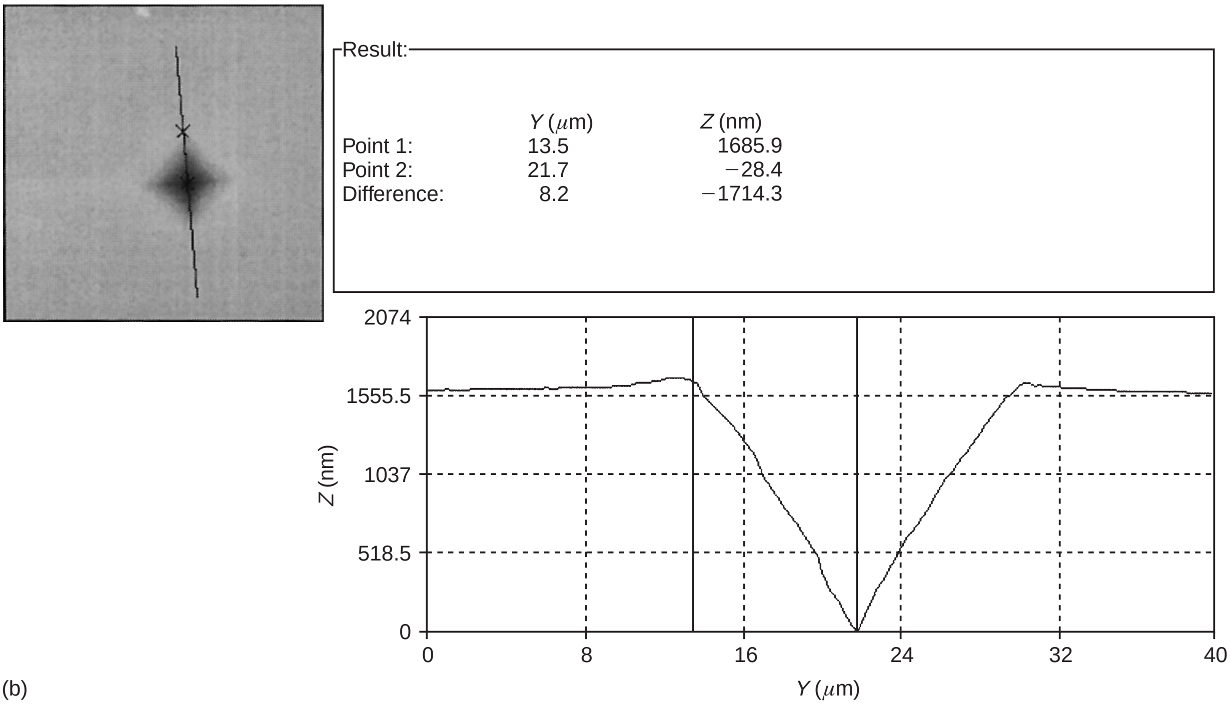

Figure 2 Continued.

We made atomic force microscopy (AFM) measurements on Vickers patterns in a silicon nitride ceramic sample with the composition 90 wt% Si_3N_4–4 wt% Al_2O_3–6 wt% Y_2O_3. Fig. 2 shows the profile of the Vickers impression for the load $P = 1.96$ N in the X–X′ (Fig. 2a) and the Y–Y′ (Fig. 2b) directions. The coordinates of the top point (point 1) and the bottom point (point 2) of the impression and the differences between these coordinates are shown in the upper parts of Fig. 2. This figure shows that the difference between the height of the bottom point of the impression and that of the top point of the pile-up in the X–X′ direction (1715.6 ± 0.8 nm) agrees well with that in the Y–Y′ direction (1714.3 ± 0.8 nm) for the silicon nitride sample.

The width of the Vickers pattern in the X–X′ direction was measured by optical microscopy as well. We found that the width measured optically (12.0 ± 0.5 μm) agrees with the distance between the top points of the pile-ups at the opposite edges of the pattern (12.4 ± 0.2 μm) determined from the AFM profile (Fig. 2a). We are of the opinion that the Vickers print contains the bulging areas in the silicon nitride ceramic sample.

Consequently our AFM observations on the Vickers pattern for the silicon nitride ceramic do not agree with the results of Iost and Bigot.

Acknowledgement

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References

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2. G. FARGES and D. DEGOUT, *Thin Solid Films* **181** (1989) 365.

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