COMMENTS

Comment on "A critical examination of the $P-h^2$ relationship in nanoindentation" [Appl. Phys. Lett. 83, 863 (2003)]

Jürgen Malzbender[a)]
Forschungszentrum Jülich GmbH, Institute for Materials and Processes in Energy Systems, 52425 Jülich, Germany

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The paper by Troyon and Martin[1] attempts to extend a load–displacement relationship previously derived by Malzbender *et al.*[2] to take into consideration the correction factor γ and the dependency of the geometric constant ϵ on the power law exponent of the unloading curve. However, in a more recent publication by Malzbender *et al.*[3] γ (although a different symbol was used) and ϵ were included in the load–displacement relationship, although the interesting mathematical relationship for ϵ was not given. Furthermore, the distance that separates the blunt extremity to the end of the cone was already considered in Ref. 2.

Troyen and Martin[1] determined for ϵ a value of 0.785 at larger loads. Based on their expression (6) this would suggest an unloading exponent m of 1.23, i.e., if ϵ is a constant that depends on the indenter geometry this would imply an indenter shape between paraboloid of revolution (sphere) and punch, which raises questions on the validity of expression (6) for elasto-plastic indentation. Even if as in the initial publication by Malzbender *et al.*[2] the value of 0.75 is used for ϵ and 1 for γ the difference for the load at a particular displacement is ~1.9% for the material investigated by Troyon and Martin.[1]

If as stated by Troyon and Martin[1] the factor ϵ is a constant that depends on the indenter geometry, which is the basis of expression (6), then independent of the material the same value of ϵ should be obtained. However, it has been shown that the unloading exponent depends on the materials properties[4,5] and hence according to expression (6) by Troyon and Martin[1] also ϵ. However, if ϵ depends on the materials properties the validity of expression (6) appears to be questionable.

[a)]Electronic mail: j.malzbender@fz-juelich.de

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