METHODS OF ACTUAL INDENTER SHAPE DETERMINATION

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Knowledge of the actual indenter shape (area function) is fundamental for the correct evaluation of measured indentation data. Various methods and models were developed for the determination of indenter area function. Nevertheless, these methods usually do not have clear geometrical interpretation and/or their application is based on some severe assumption so they cannot be applied generally. Basically, the shape of the indenter can be determined by two different procedures – indentation into reference materials with known mechanical properties or reconstruction of the tip by direct imaging methods, e.g. AFM.

The aim of this study is the comparison of these two procedures applied for characterization of Berkovich and spherical diamond indenters. Several materials were used for reference indentation measurements and it was found that the area function obtained on studied materials significantly differs. The area function determined by this technique in fact does not correspond to the actual indenter shape but it characterizes the convolution of actual indenter shape and material surface and deformation characteristics. It means that this technique is appropriate only while testing the materials with the properties close to the reference sample.

On the other hand, AFM measurements give information about actual shape of the indenter in details that cannot be gain from the reference indentation. Information about Berkovich indenter blunting were obtained by various methods of AFM data analysis and the differences were explained. It was also found that not only the apex of Berkovich indenter but also the edges are rounded. In the same way, the tip of spherical indenter can be significantly blunted. Moreover, the crystallographic orientation of the used diamond is very important and it affects the shape of the tip and causes important deviations from the ideal spherical shape.

This contribution shows that attention should be paid during indenter calibration and subsequent indentation data analysis. The area function used for data evaluation has to be carefully chosen regarding the material under investigation.

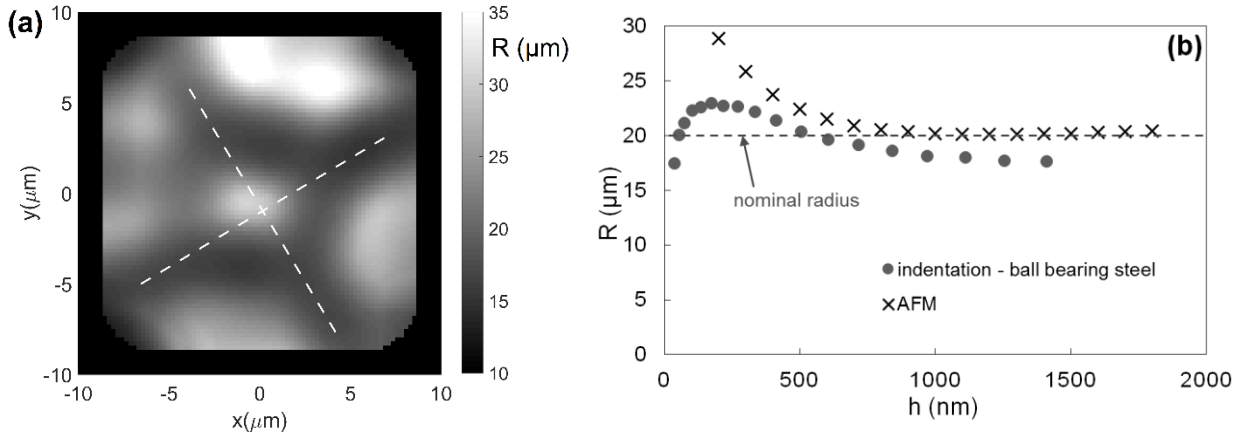

Figure 1 – (a) Local radius of spherical indenter with nominal radius 20 μm (dashed lines show the four-fold symmetry of used diamond crystal) and (b) change of the radius with the distance from the apex obtained by AFM and by indentation on reference materials.

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