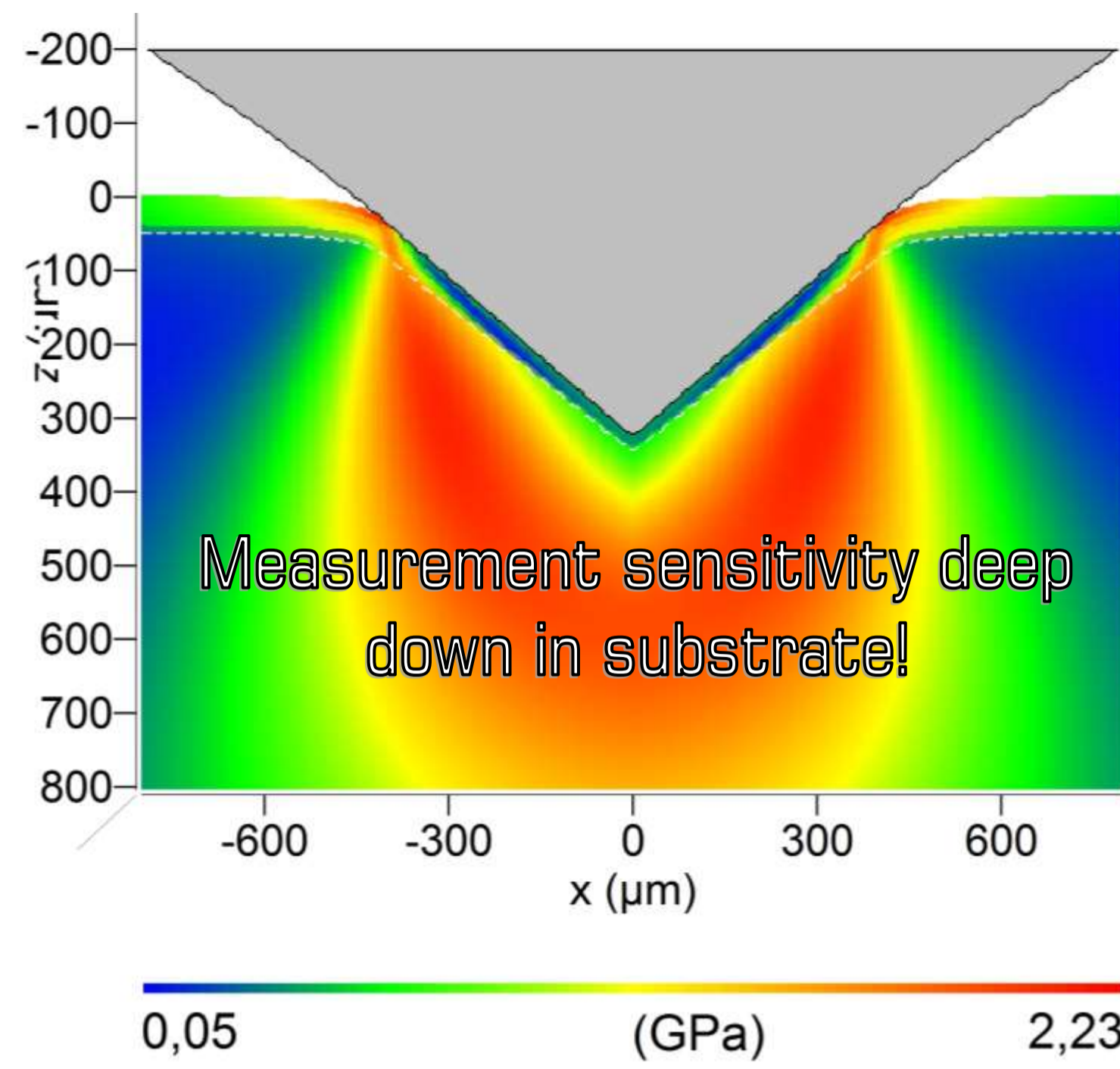


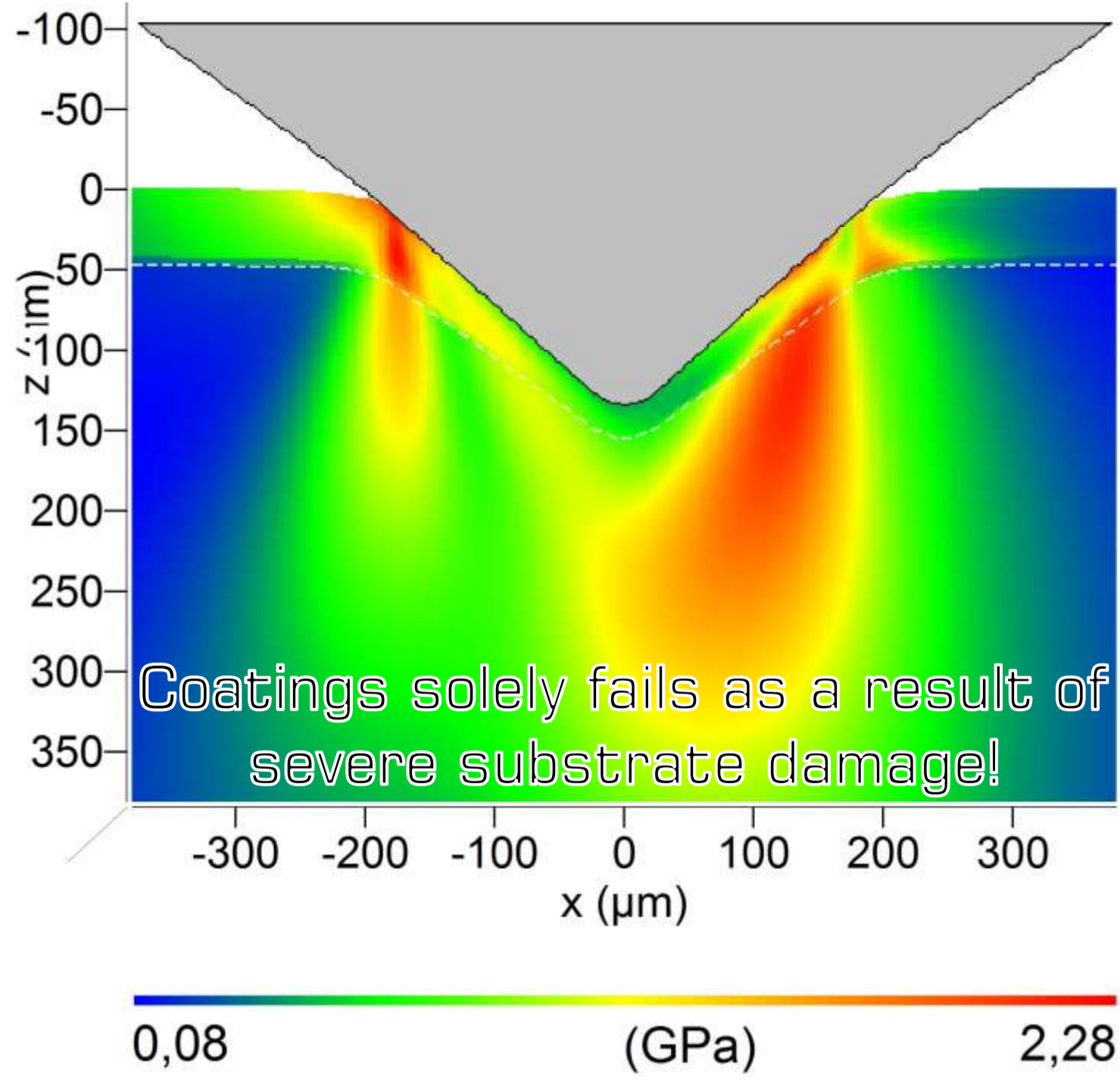
Why should contact experiments on thin films be designed properly?

Unfortunately, many industry standards are not or only ill-suited to coatings — particularly thin films or complex coating structures — or lack of physical substance (see examples on the right). In addition, such standard experiments do not match operating conditions often and hence, their results do not correlate to performance of the surface in operation. However, significant measurement information is necessary for a sound determination of mechanical properties of the coating or interface as well as a physical analysis of failure mechanisms. In this regard the 1/10 rule does help in any way.

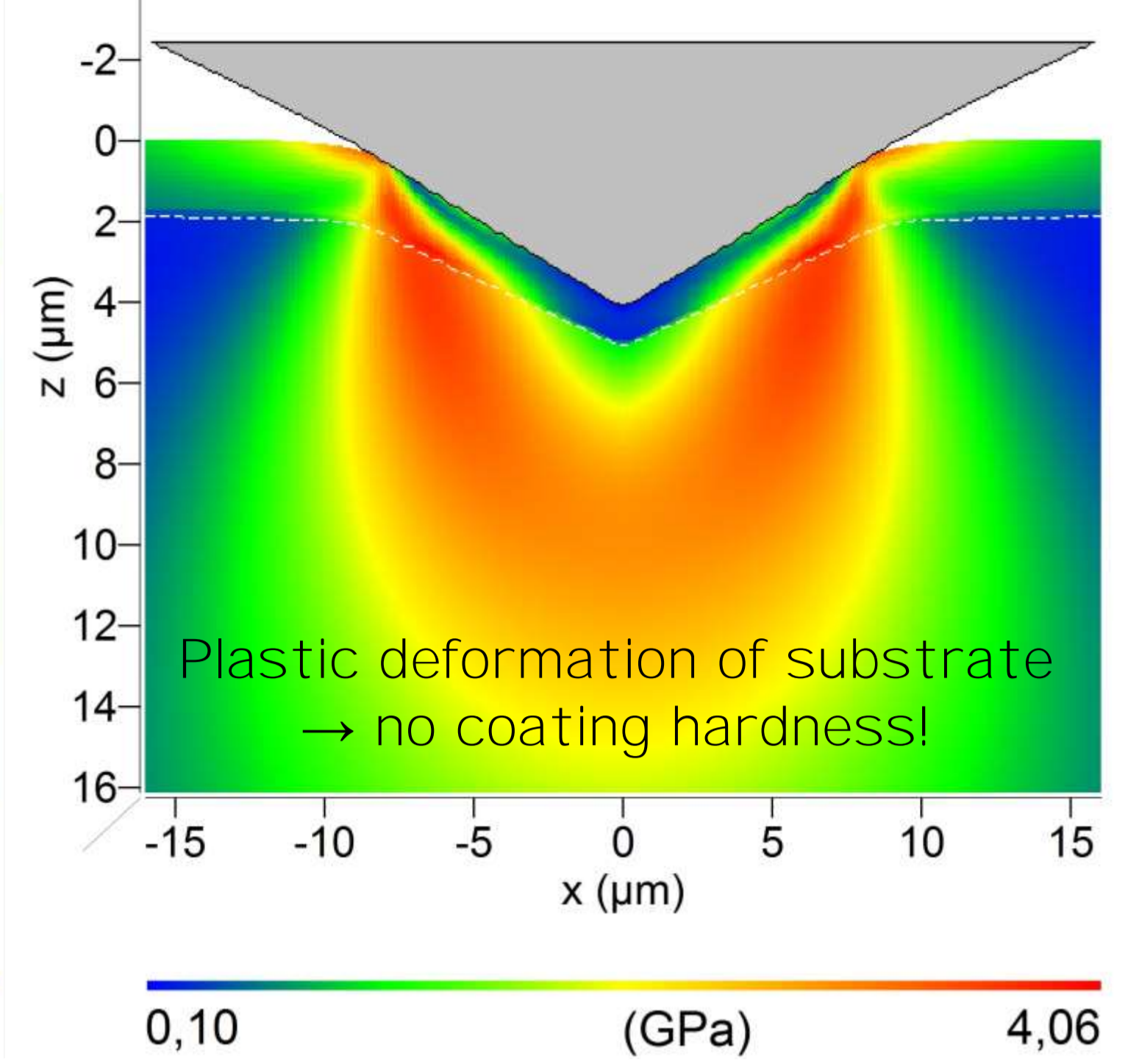
Rockwell HRC test on 20 μm TiN on steel substrate



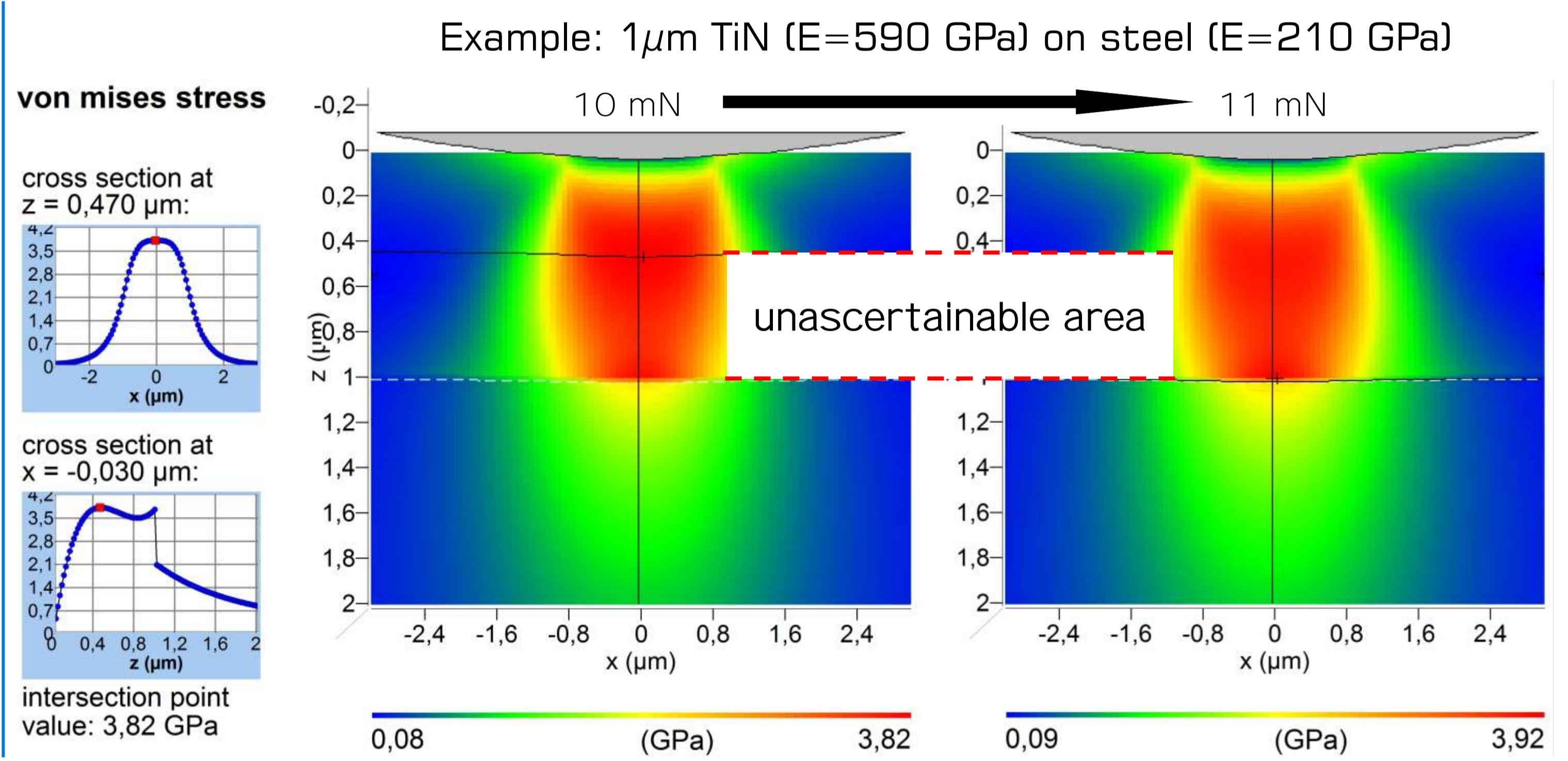
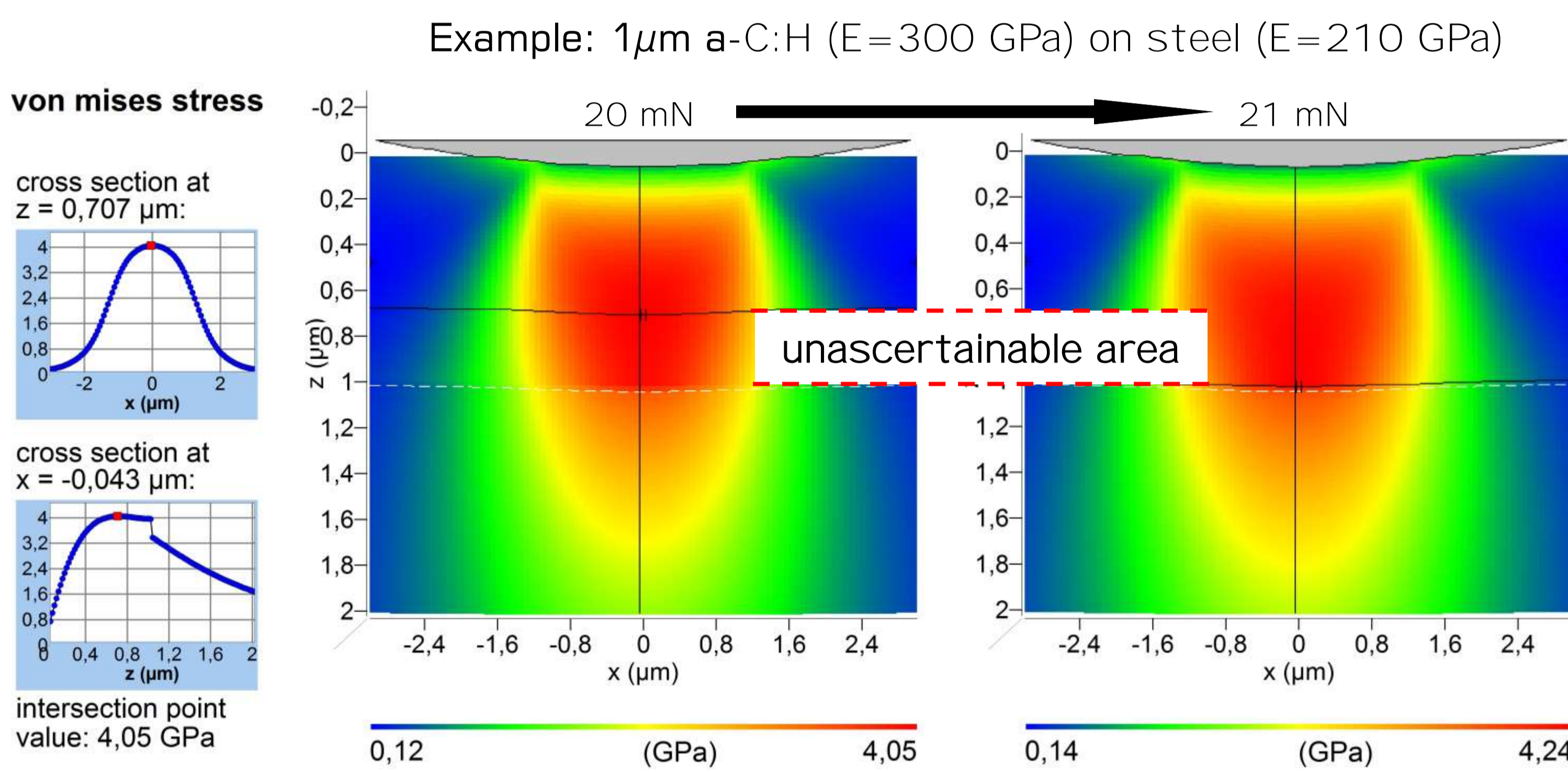
Scratch test as per DIN EN 1071 or ASTM C1624 on 20 μm TiN on steel



HV 0.1 on 1 μm TiN on steel substrate

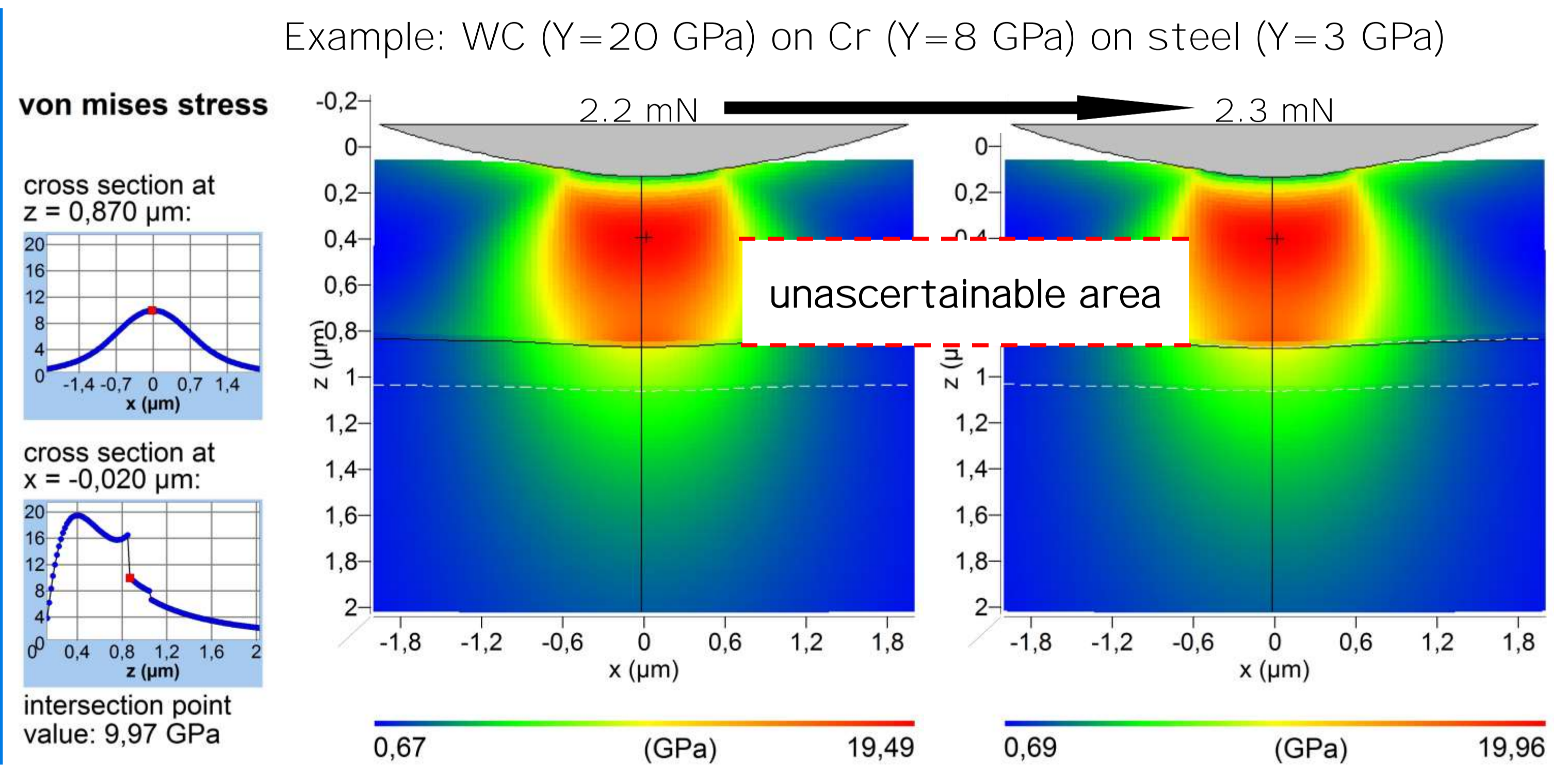
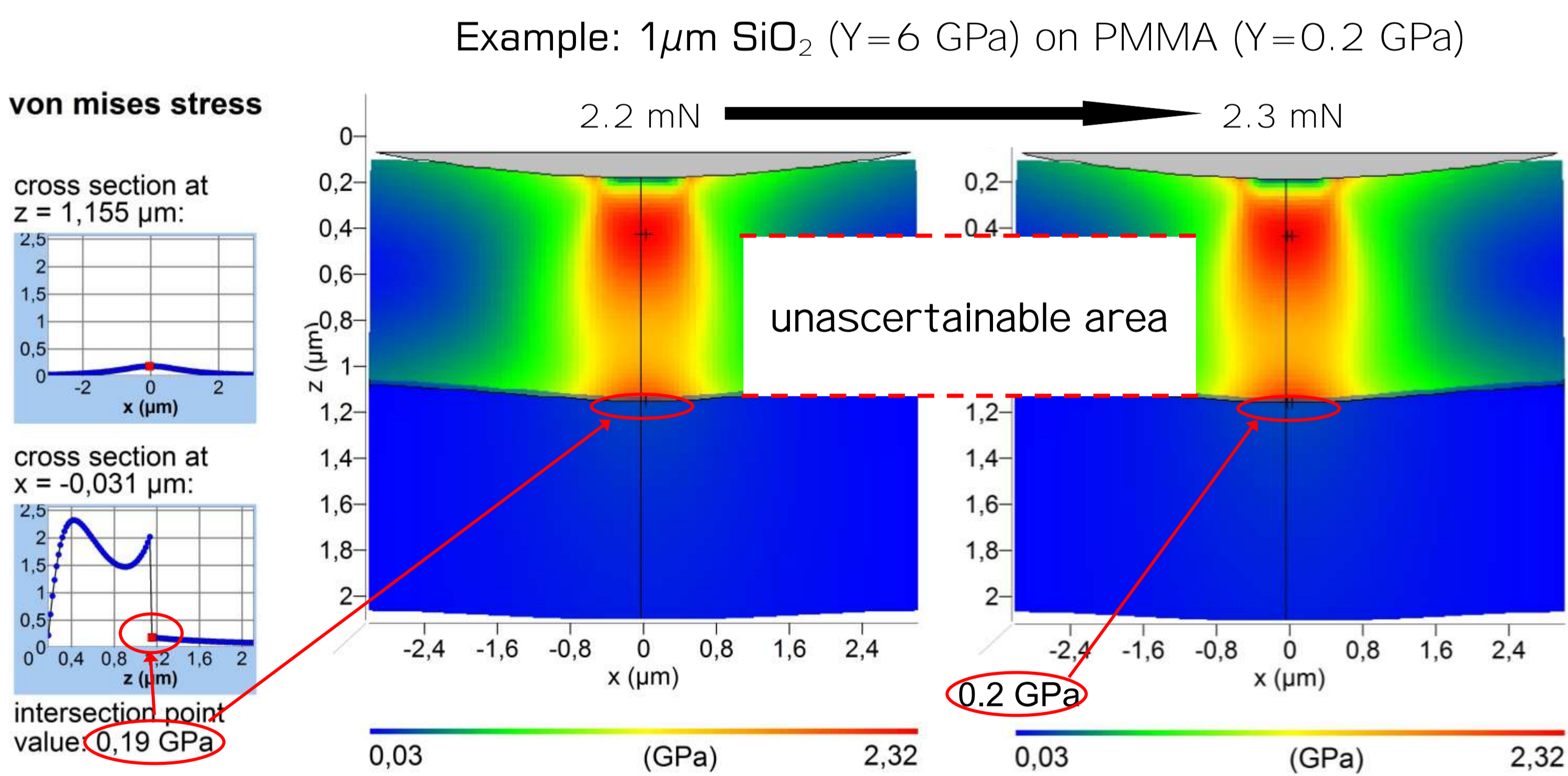


Are there any pitfalls? Yes, E-Shadowing due to egg shell effect!



There are unascertainable areas in layered surface structures due to different elastic properties. The more compliant substrate shadows a part of the coating.

Are there even more pitfalls? Yes, Y-Shadowing due to yield strength ratio!



It is not possible to extract information (e.g. determin elastic modulus E, hardness H, or yield strength Y) from any depth of interest due to the softer substrate.

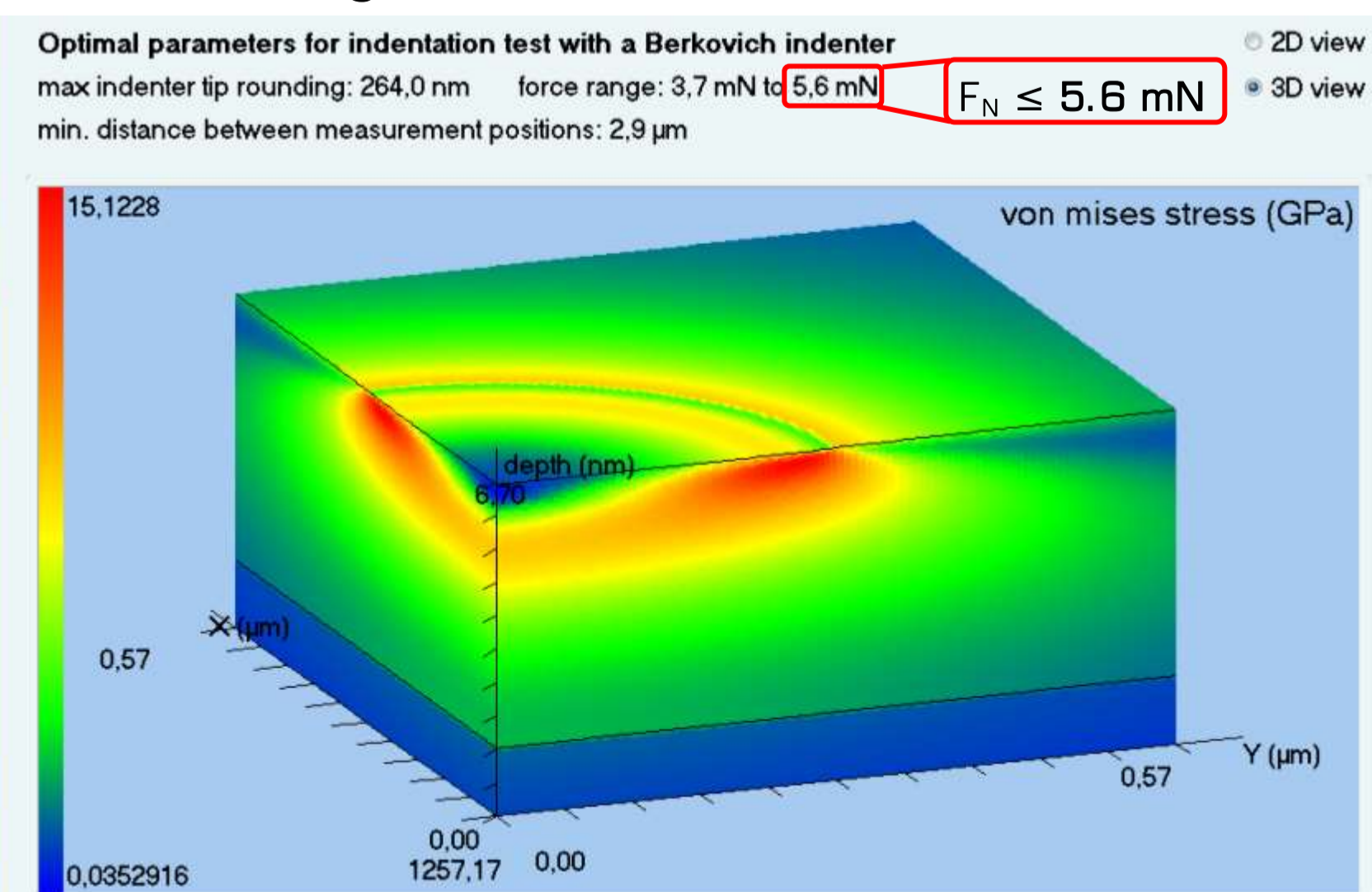
How to design contact experiments on coated or treated surfaces?

1st step: material definition

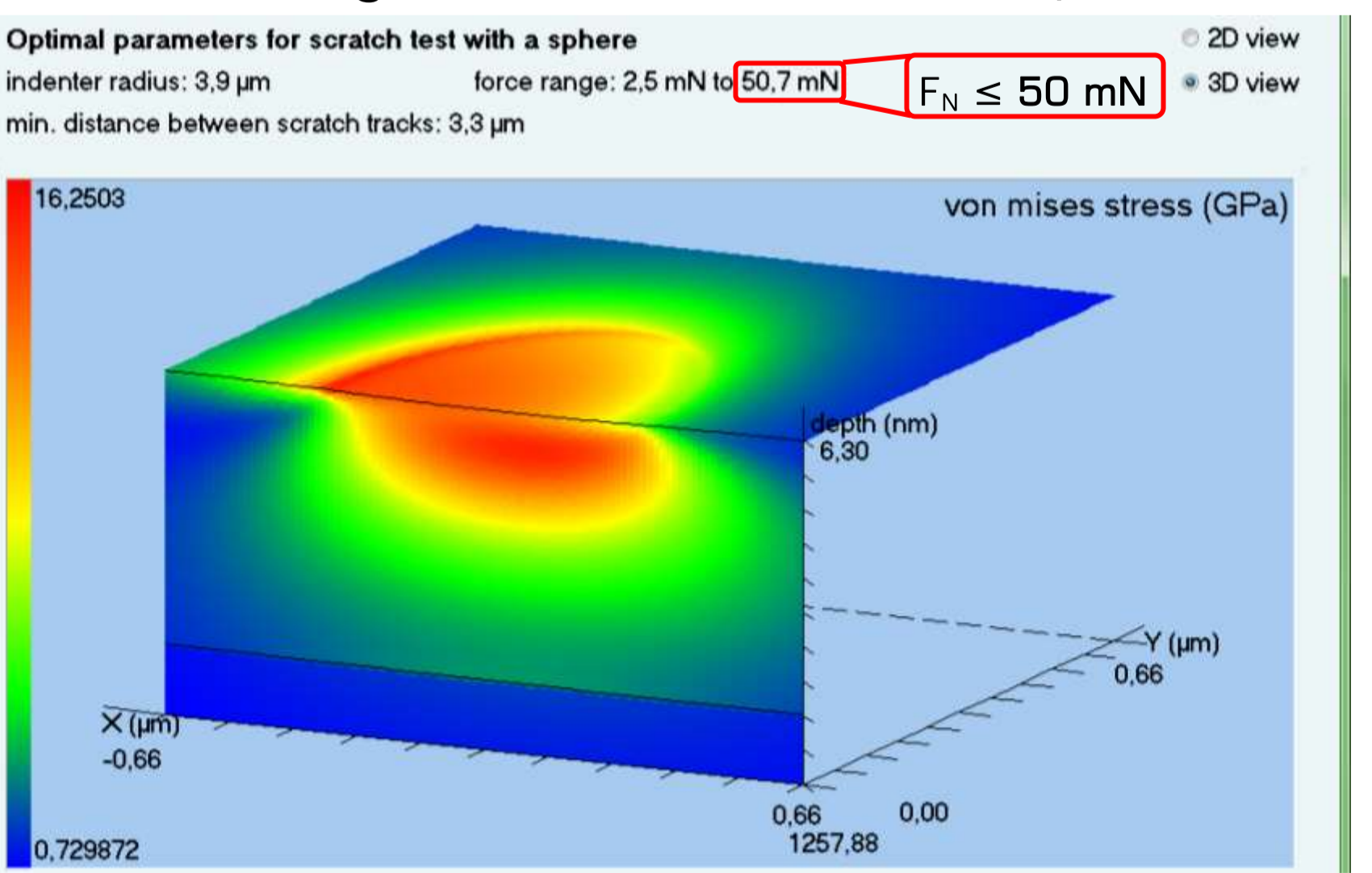
2nd step: define design goal (point of interest POI)

3rd step: select experiment types to be designed

a well-designed indentation test on 1 μm TiN



a well-designed scratch test on 1 μm TiN



Only three simple steps are necessary using easy tools like Test Optimizer (www.siomec.de/TestOptimizer). It can help you to properly design contact experiments on arbitrarily structured surfaces (e.g. coated or treated surfaces) avoiding pitfalls like the above mentioned shadow effects.

Conclusions

Proper design of contact experiments is important and possible using the method presented.