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Modeling Tribology Using FilmDoctor®

Full story at www.siomec.de/pub.

1. Material definition and intrinsic stress simulation

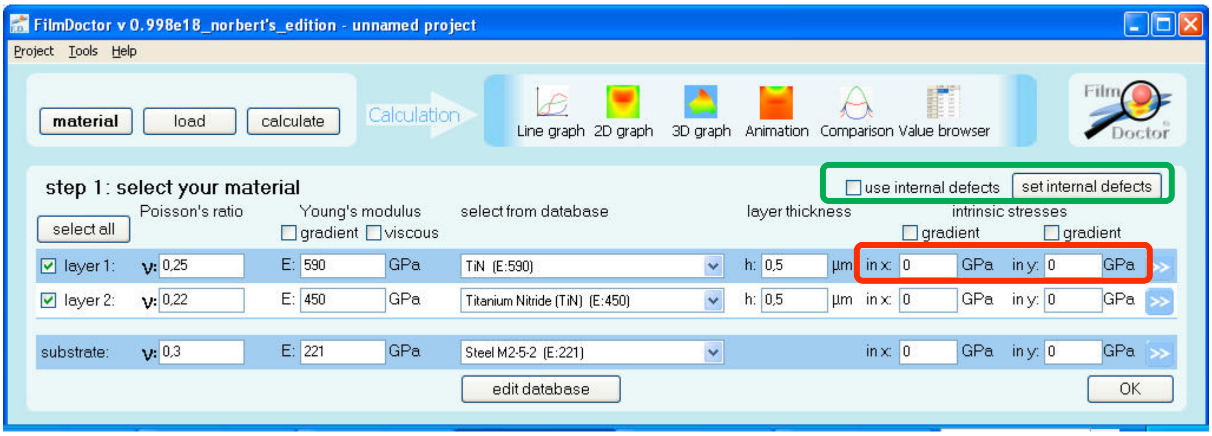

Fig. 1: **Defining your material structure. Simulating intrinsic stresses correctly by the means of analytical interface defects.**

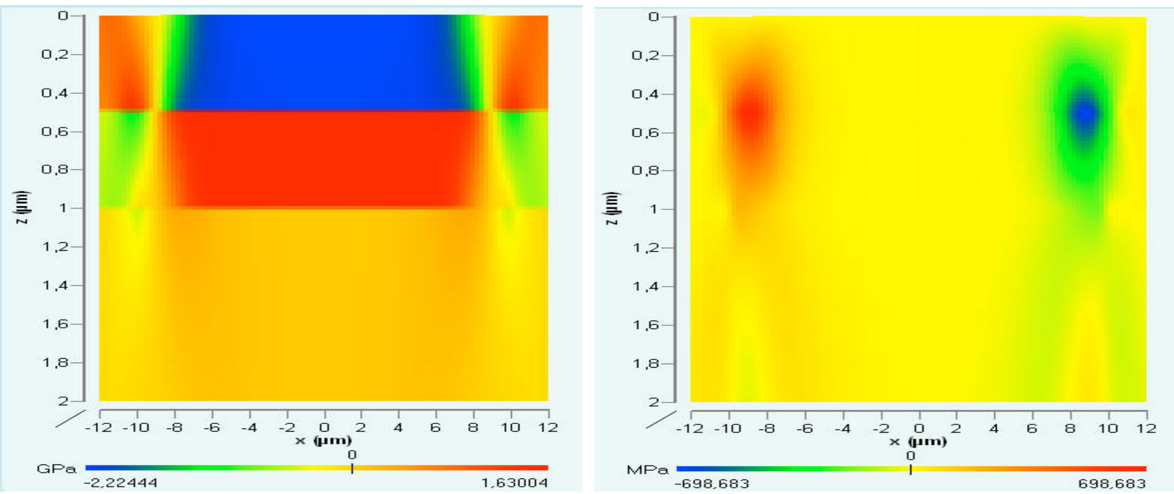

Fig. 2: **Intrinsic stress in x-direction (left) and intrinsic shear stress xz (right) caused by a local thermal expansion mismatch between first coating and substrate.**

2. Modeling a tribological load-situation

Next step is to find the loading conditions simulating the later application and / or surface test method. Here we assume a tribological contact with asperities decreasing the fluid film between the contact pairing. The typical well know EHD-stress distribution can be constructed by the means of our load dot method (Fig. 3, red ellipse). For more sophisticated investigations also direct contact pairings and / or roughness geometries can be solved (Fig. 3, green rectangle) and then summed up using the load dot method again.

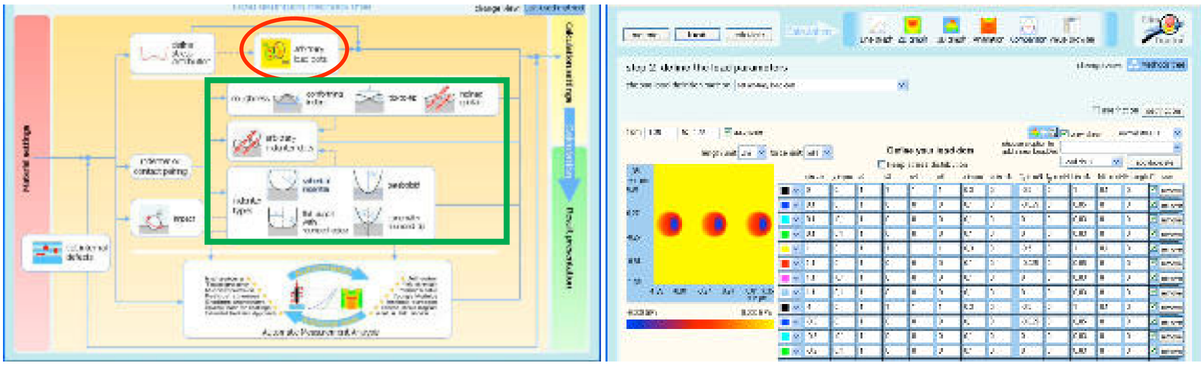

Fig. 3: Choosing a load method (left). Here (red ellipse) the load dot method is used. By clicking on this symbol the program jumps directly to the load dot page (right). Here a load dot ensemble for the simulation of an asperity tribo-problem with the typical EHD-stress distribution is defined. Lateral and tilting loads are also included.

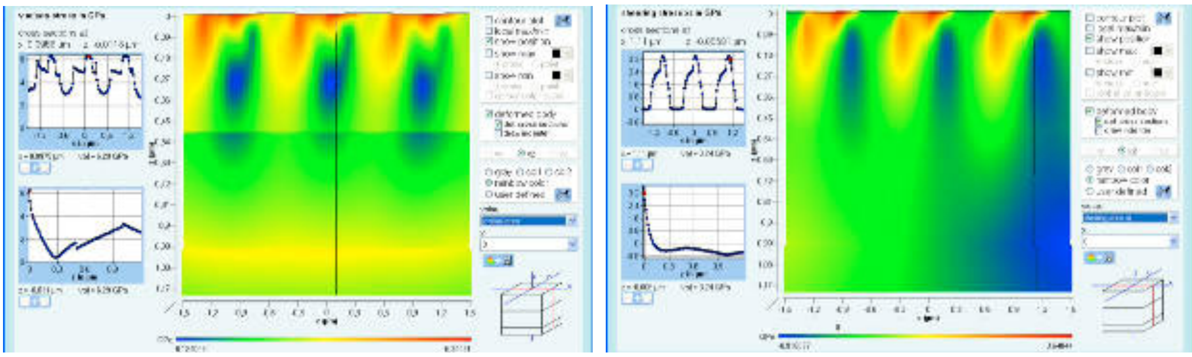

Fig. 4: Left → von Mises stress, giving the likelihood of plastic flow in either coating-system or substrate or both.
Right → Shear stress, e.g. giving information on coating delamination (due to Mode II fracture).

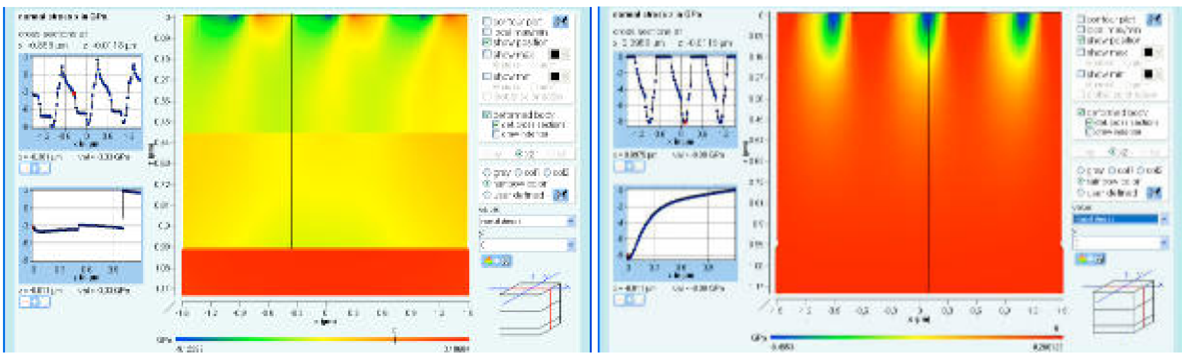

Fig. 5: Left → Normal stress in lateral direction as a result of an external tribo-load (s. below) and two layers with intrinsic compressive stresses. The maxima behind the asperities (red areas on the surface z=0) might cause tensile (Mode I) fracture and lead to initial failure.
Right → Normal stress in direction of the surface normal.

3. A few words about wear-modeling

Why an extended Archard's law, though? → Answer at www.siomec.de/pub

Also much more complex material structures up 100 layers, real gradients plus intrinsic or residual stresses and viscous behavior can be modeled.