Tutorial 196.01: Manipulation of Surface Profiles

This tutorial shows how surface profiles of optical interfaces can be manipulated in VirtualLab™. Definition areas (apertures), scaling, pixelation, quantization, Fresnel zones, and periodization are discussed.

Keywords: Surface Profile, Optical Interface, Definition Area, Scaling, Pixelation, Quantization, Periodization, Fresnel Zones

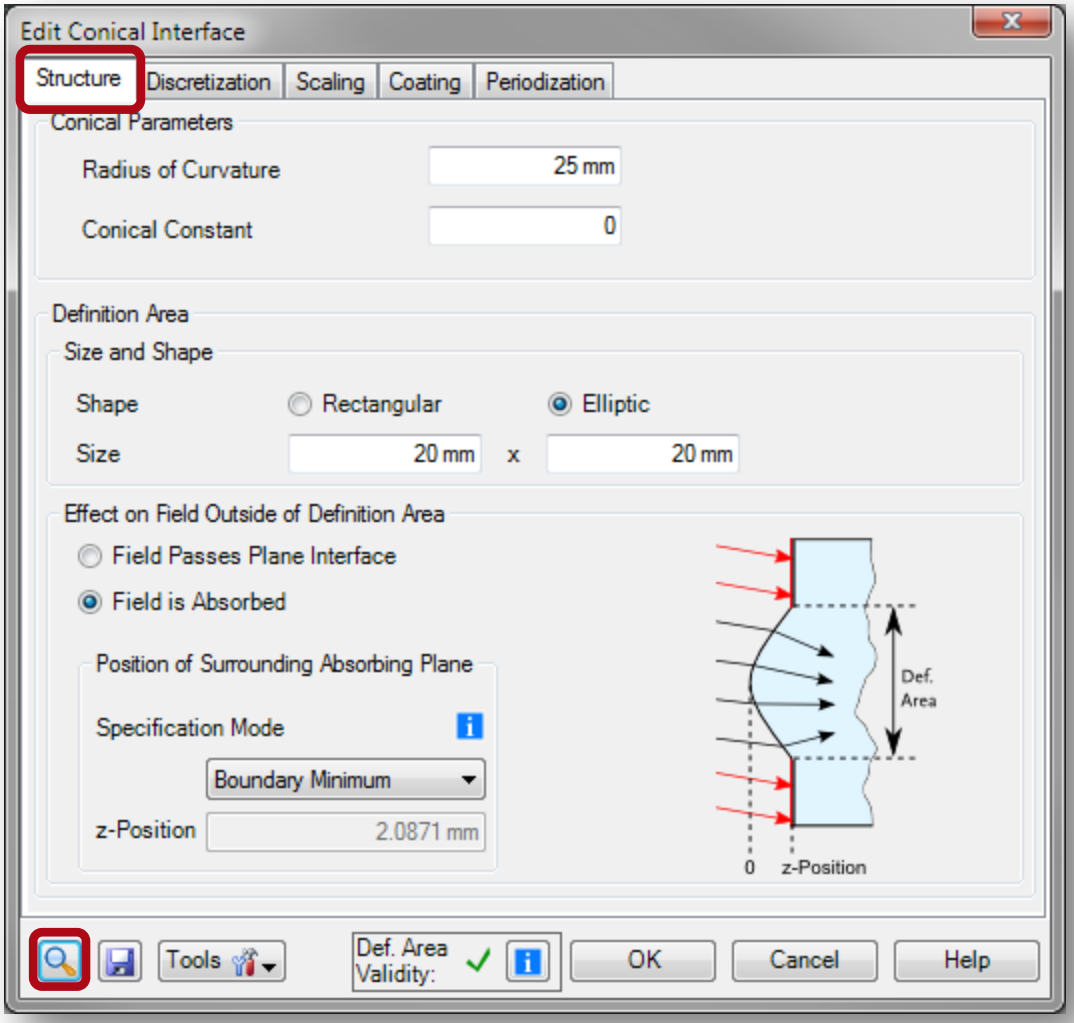
Required Toolboxes: Any Toolbox

LIGHTTRANS

Contents

- The tutorial discusses options provided by VirtualLab™ for the definition of surface profiles of optical interfaces:
  - Definition area
  - Outer Plane with or without absorption
  - Pixelation, quantization, and Fresnel zones
  - Scaling in x-, y- and z-direction
  - Periodization
- The methods apply to any interface.
- The methods can be combined. For clarity, the tutorial considers them one after another.
- For simplicity, let us consider a Conical Interface.

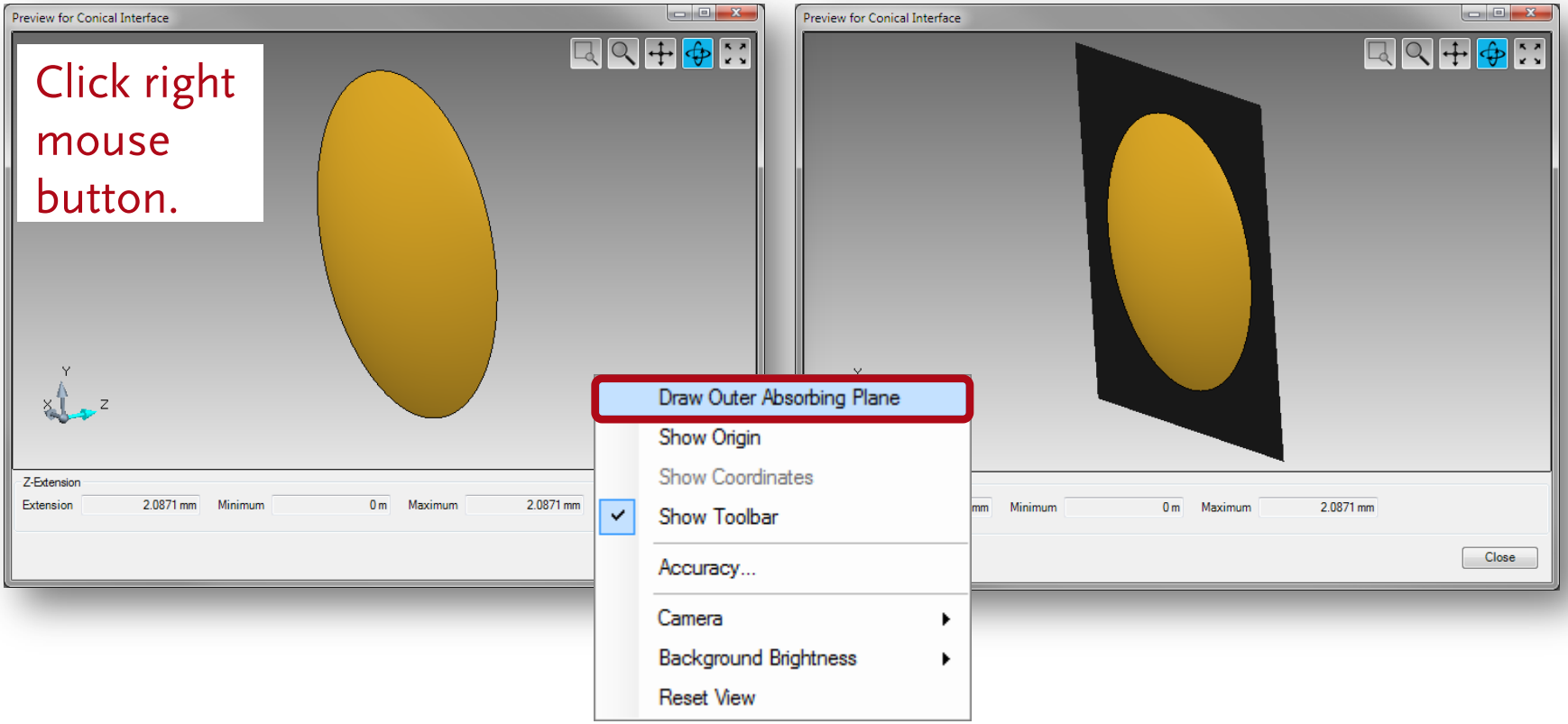
Edit Dialog of Conical Interface



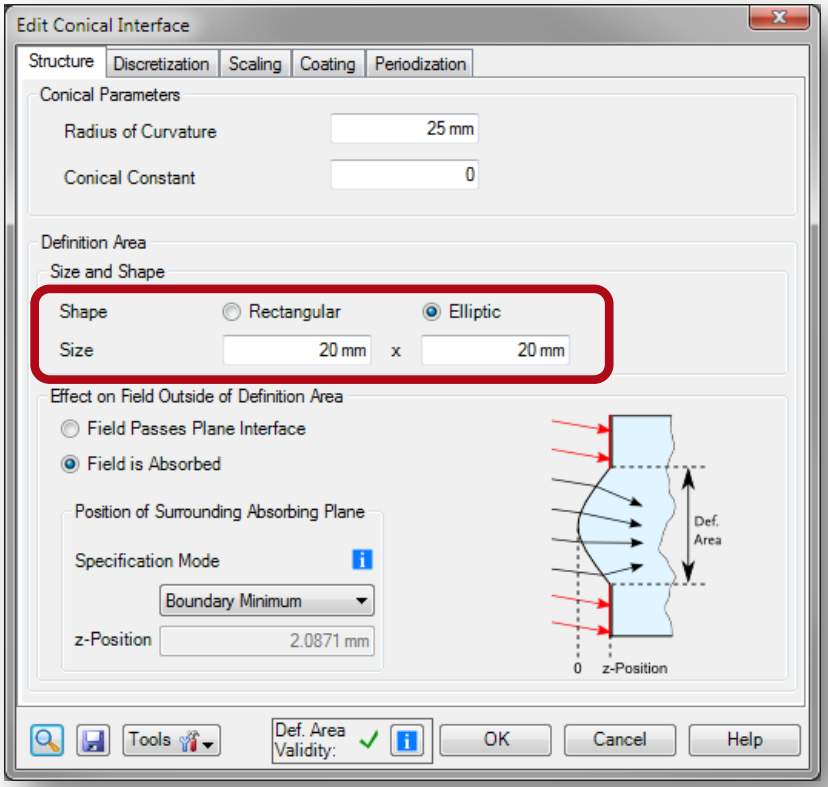
3-D View of Conical Interface

View without outer definition area.

View with outer definition area.

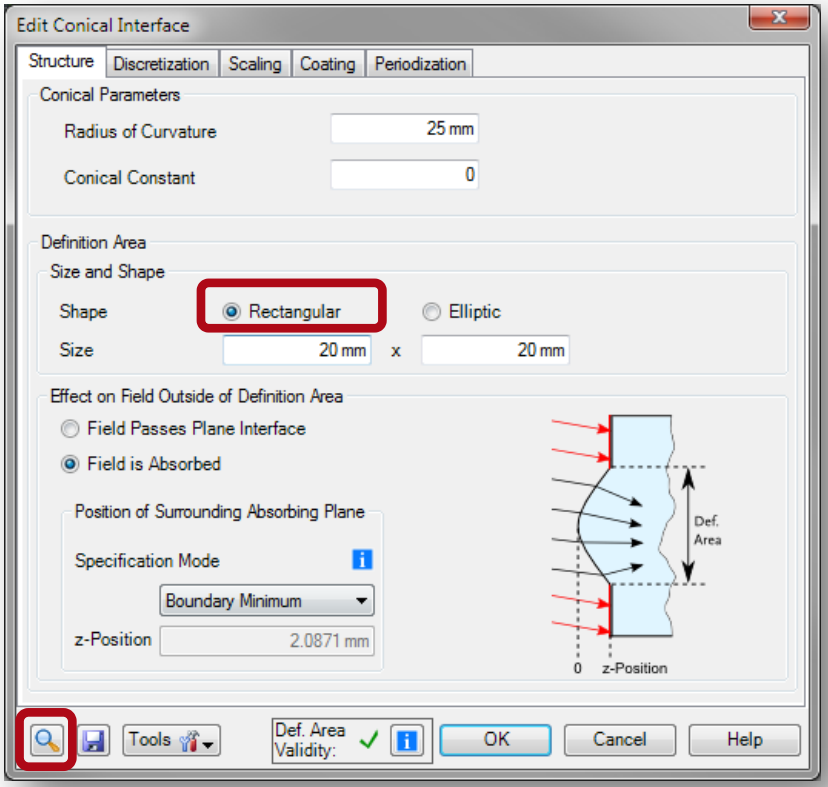


Size of Definition Area



- The definition area has to be defined. This is the region where the formula of the height profile (conical) is being applied.
- Often there is a maximum size due to the domain of definition of the formula, here twice the radius of curvature.

Shape of Definition Area

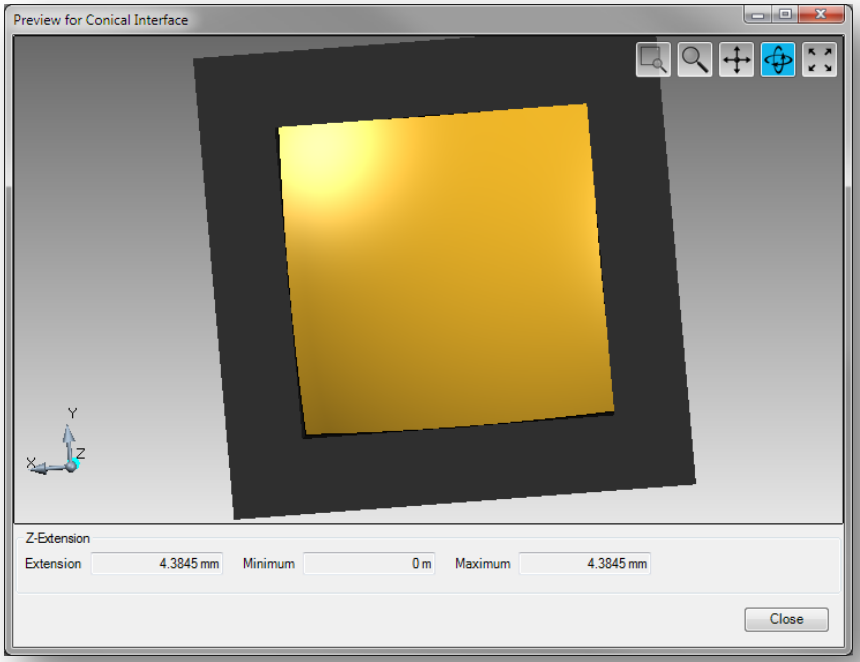


The definition area can be of elliptic or rectangular shape.

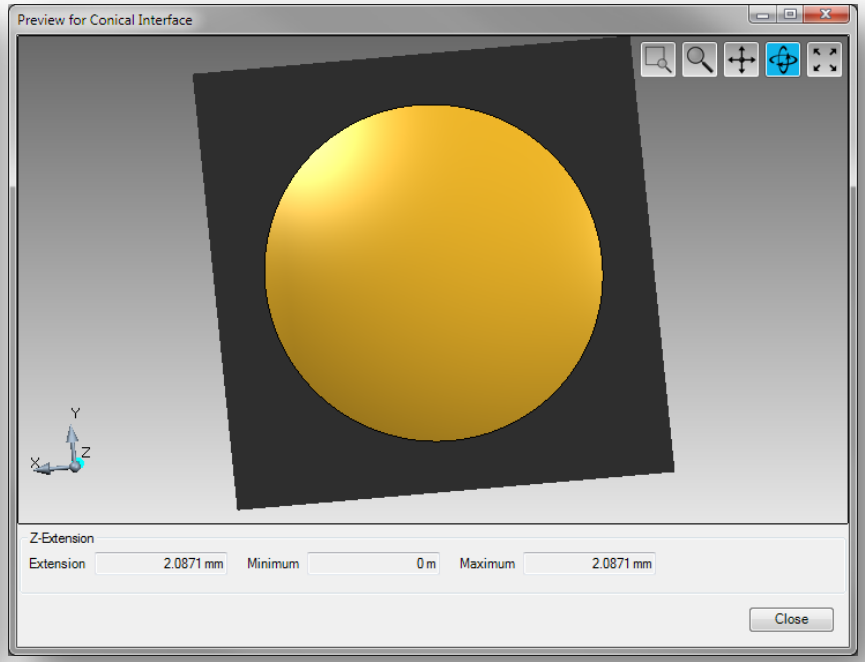
Results in

Shape of Definition Area

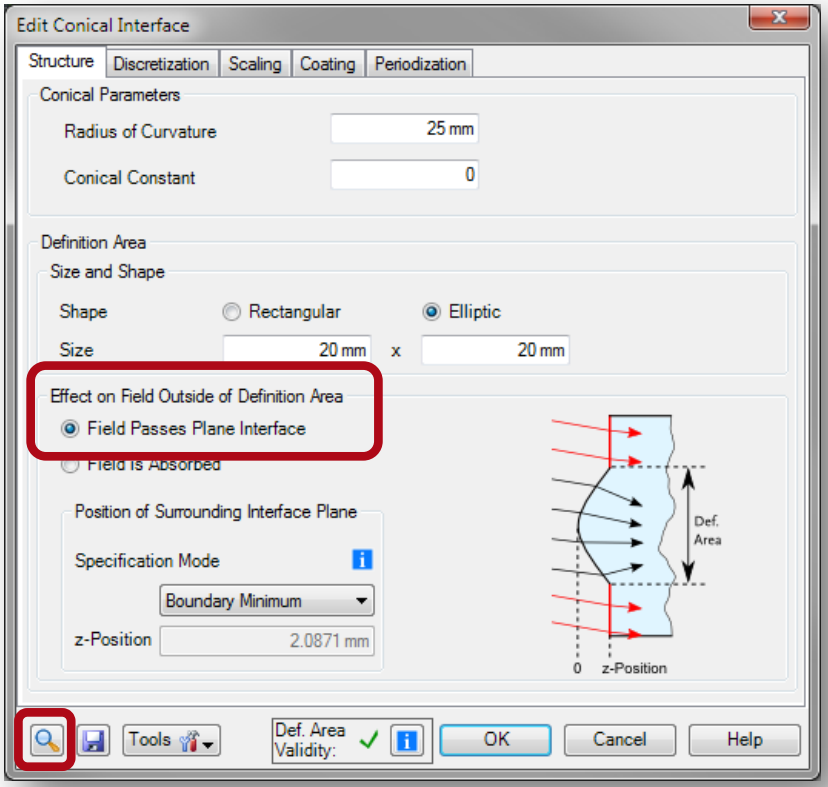
Rectangular shape of definition area.



Elliptic shape of definition area.



Effect on Field Outside of Definition Area

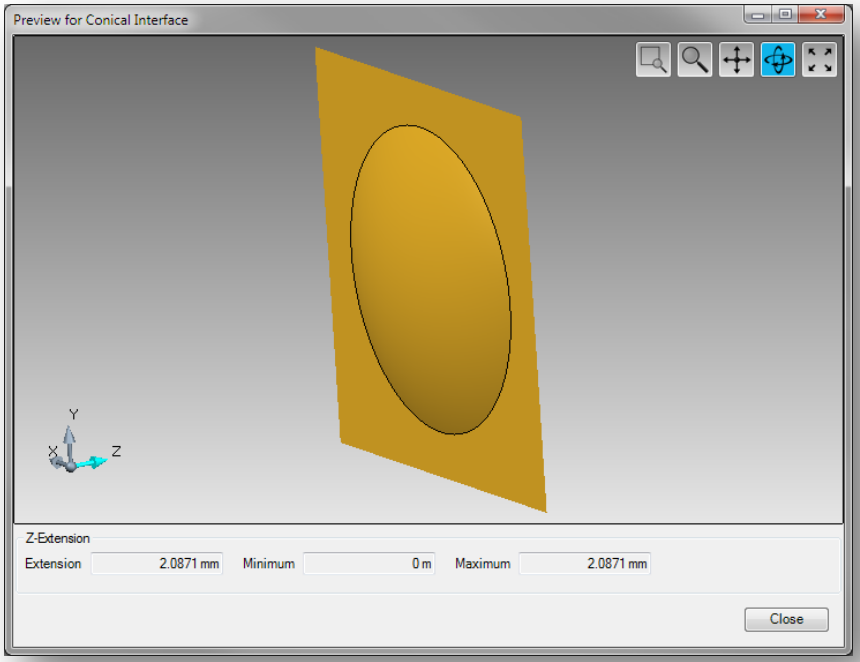


- The interface can be defined such that the field is absorbed outside the definition area.
- Alternatively, the surface profile can be defined as plane interface without absorption outside the definition area.

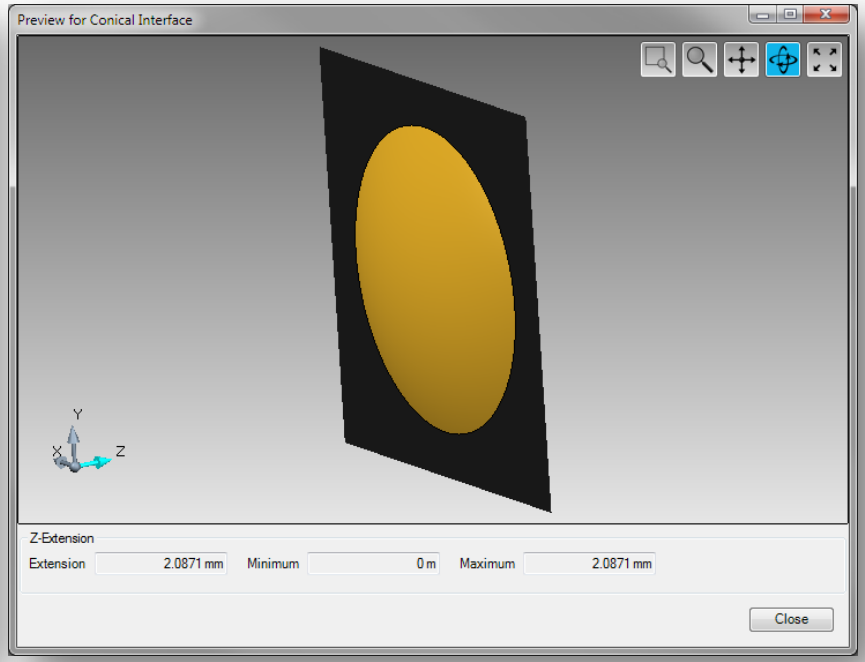
Results in

Effect on Field Outside of Definition Area

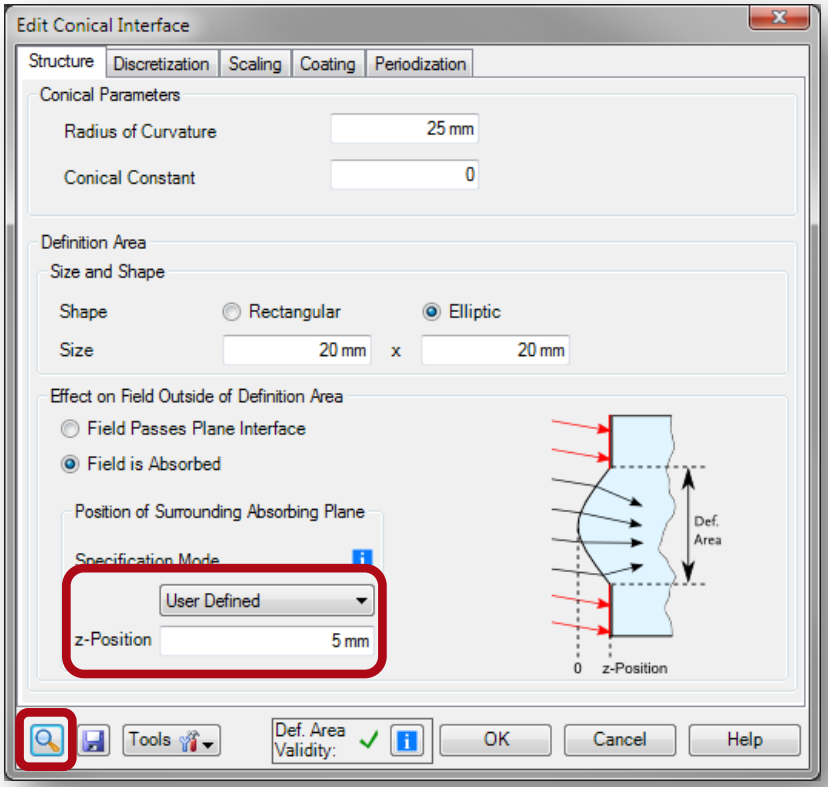
Colored surfaces indicate that the field passes the interfaces.



Black regions indicate that the field is absorbed.



Z-Position of the Outer Interface Plane

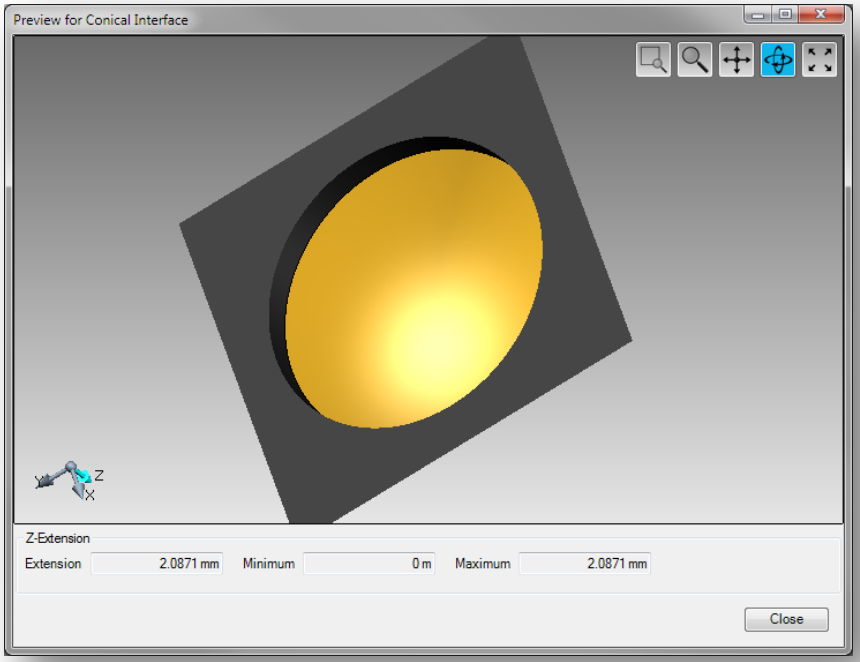


The z-position of the outer interface plane can be either the *Area Maximum*, the *Area Minimum*, the *Boundary Maximum* or the *Boundary Minimum*. Alternatively, you can set an *User Defined* z-Position.

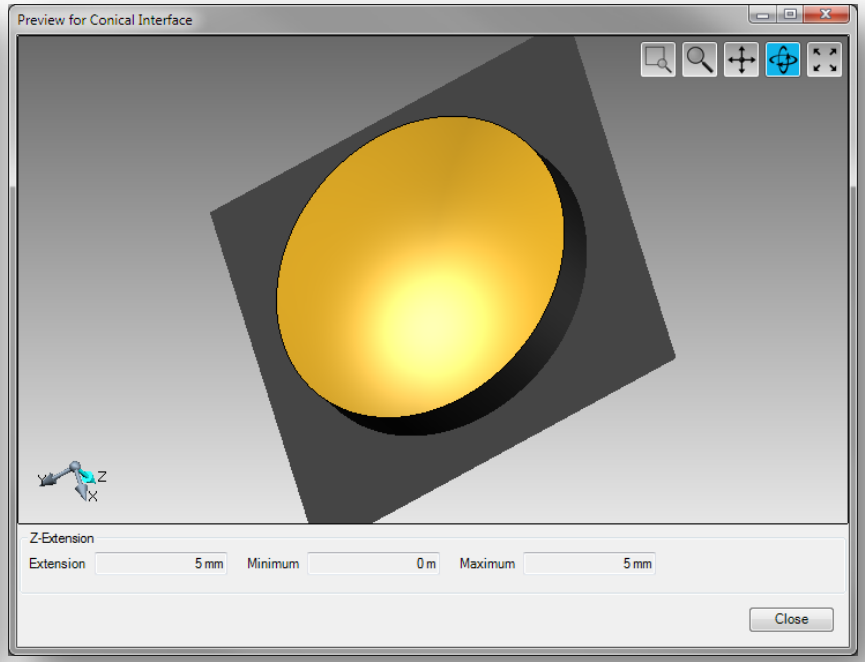
Results in

Z-Position of the Outer Interface Plane

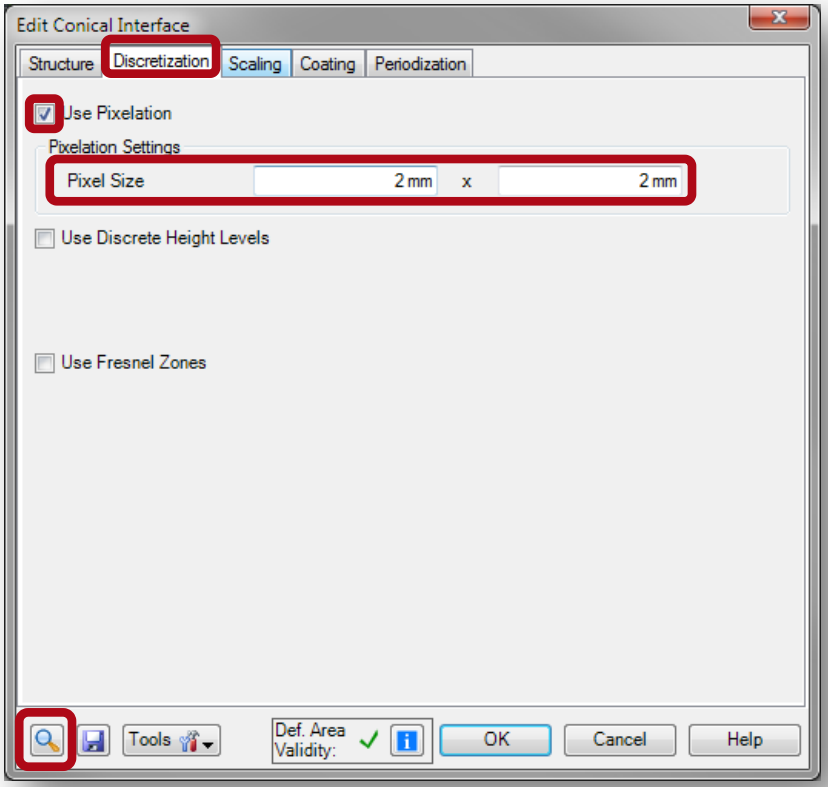
Z-Position set to the Area Minimum



User Defined z-Position z = 5 mm.



Pixelation

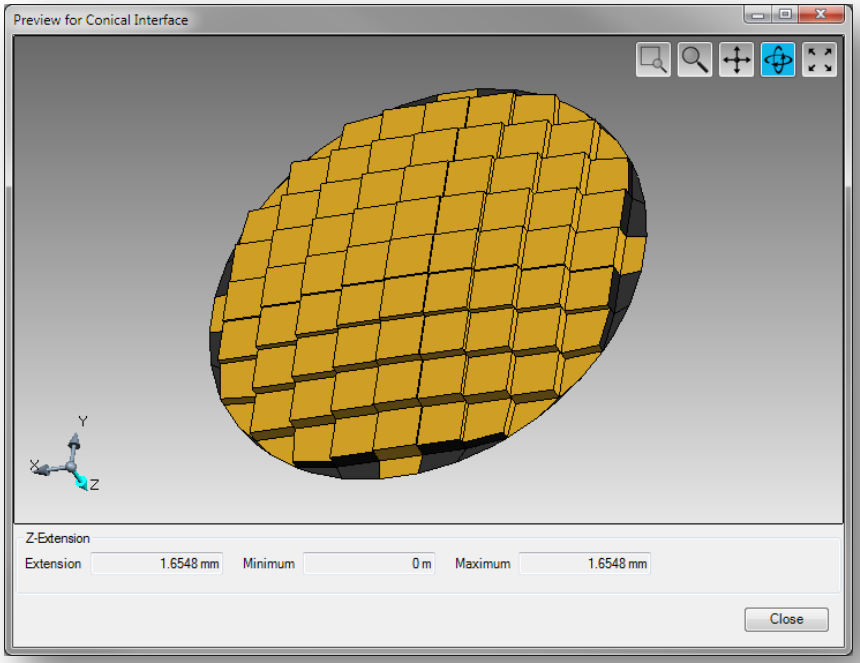


- The surface profile can be defined to be pixelated. Then the height is constant for each pixel. The height value is taken at the center of the pixel.
- Formulas are given in the manual (section “Optical Interfaces”).

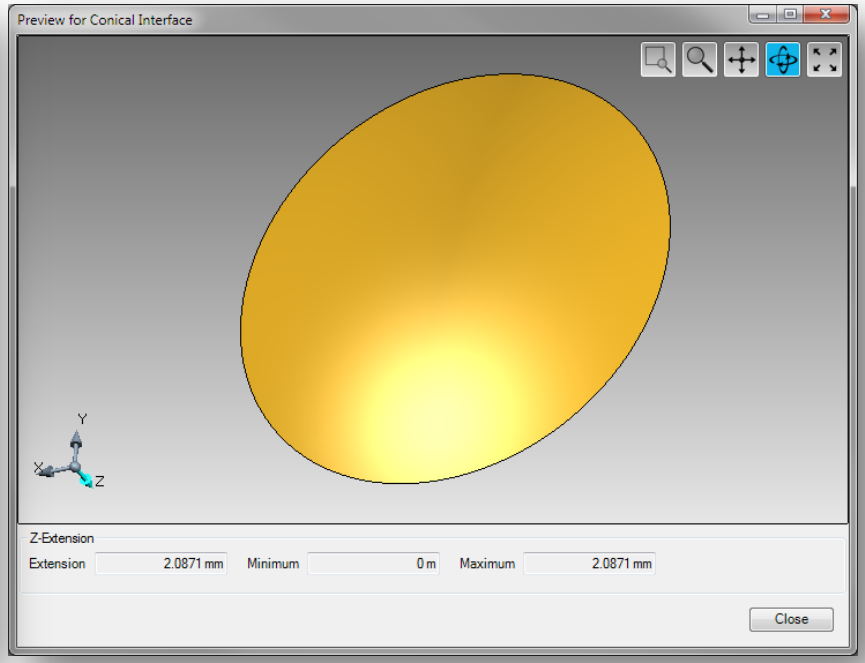
Results in

Pixelation

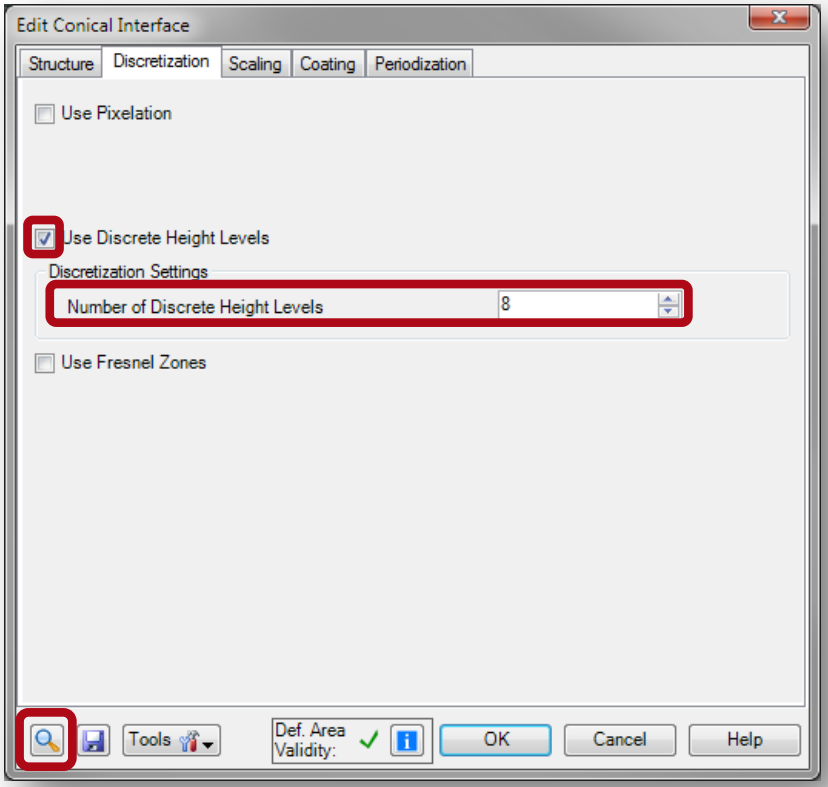
Surface profile with pixelation.



Surface profile without pixelation.



Quantization

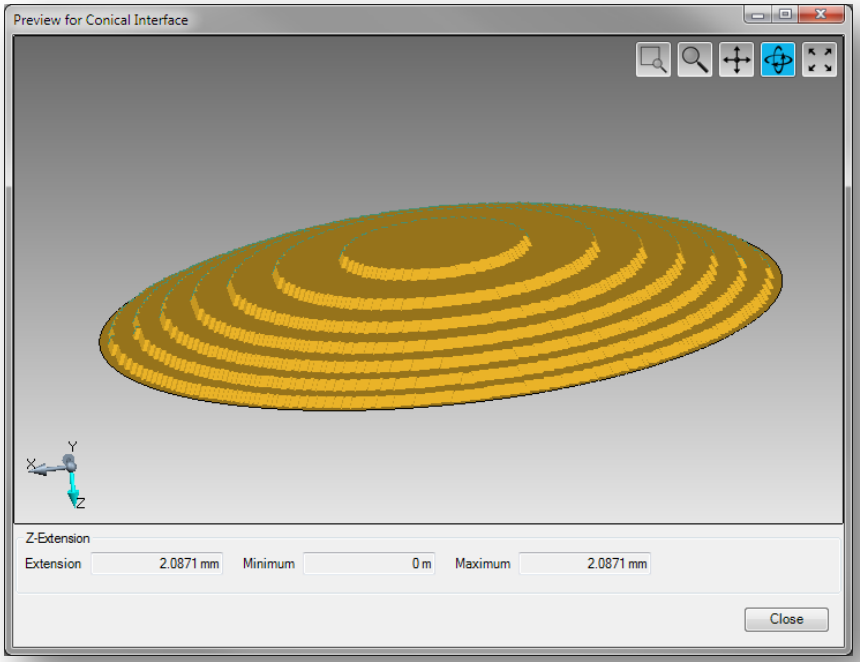


- The surface profile can be quantized with a given number of discrete height levels.
- Formulas are given in the manual.

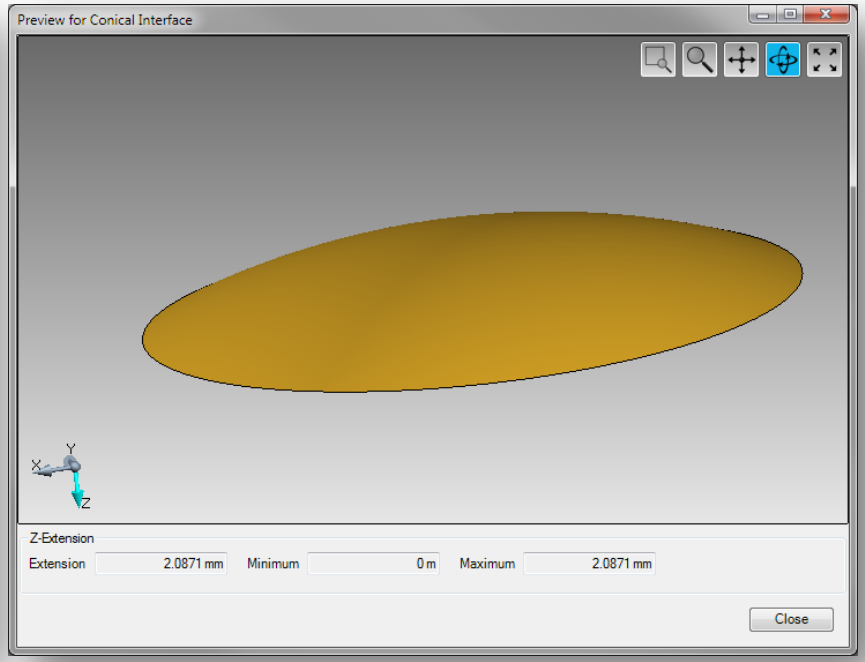
Results in

Quantization

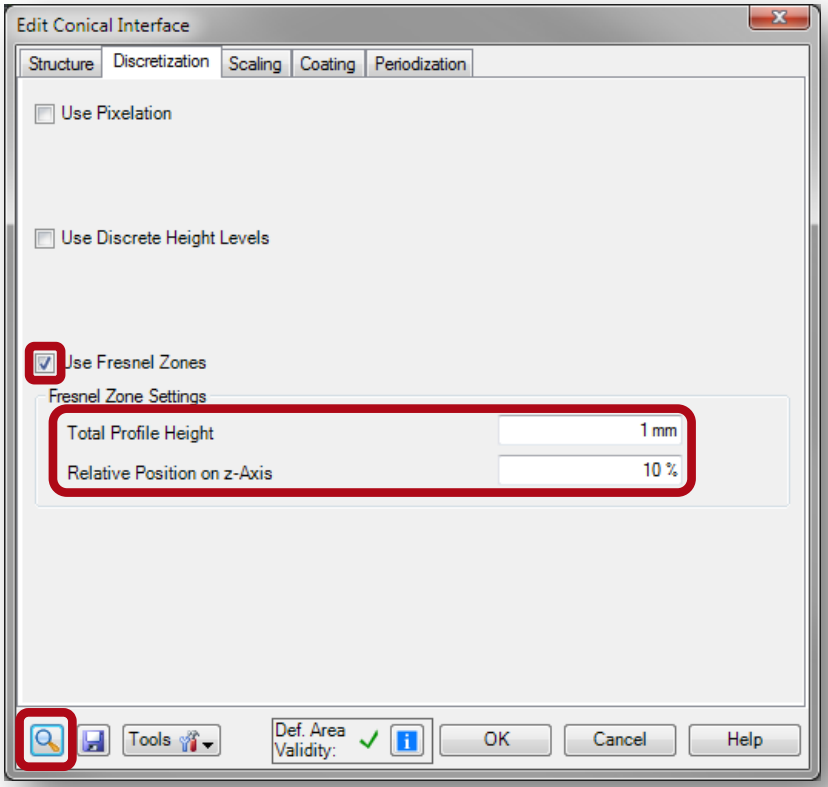
Surface profile with quantization.



Surface profile without quantization.



Fresnel Zones

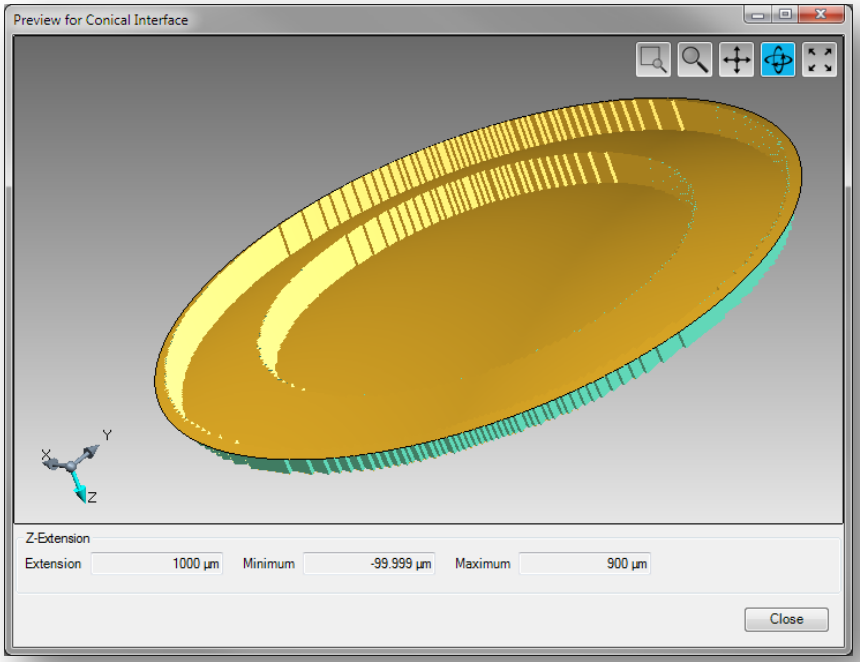


- Fresnel zones can be introduced for every interface.
- *Total Profile Height* as well as *Relative Position on z-Axis* can be set.
- Formulas are given in the manual.

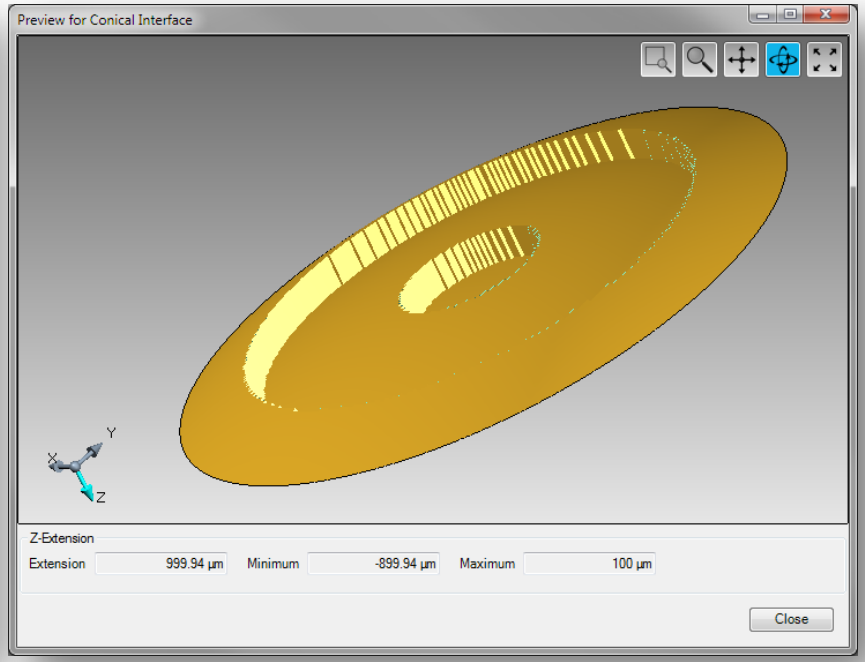
Results in

Fresnel Zones

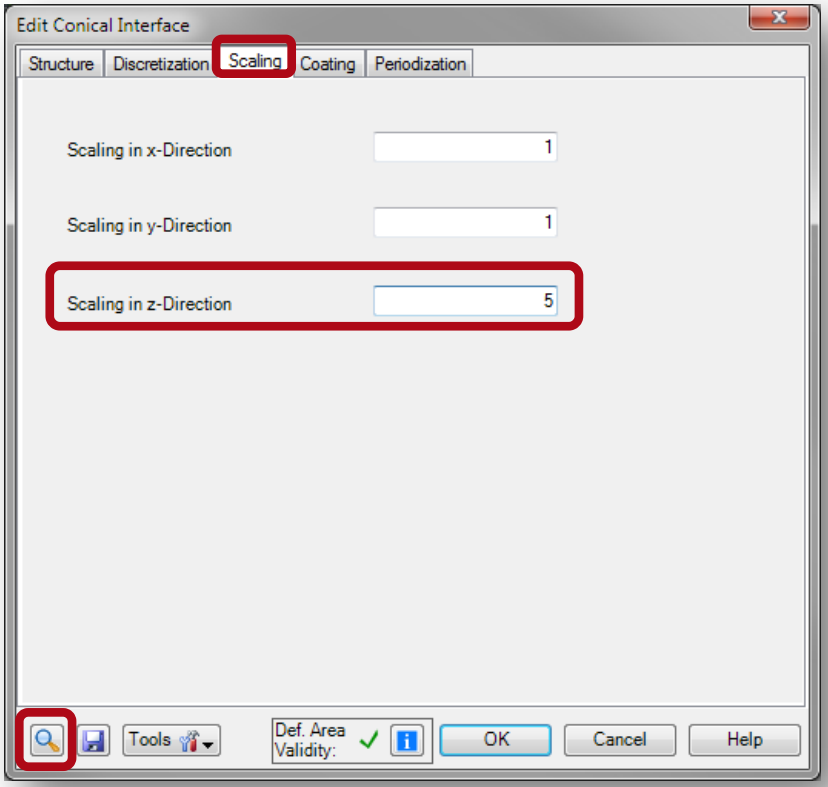
Fresnel zones with total profile height of 1 mm and relative z-position of 10 %



Fresnel zones with total profile height of 1 mm and relative z-position of 90 %



Scaling in z-Direction

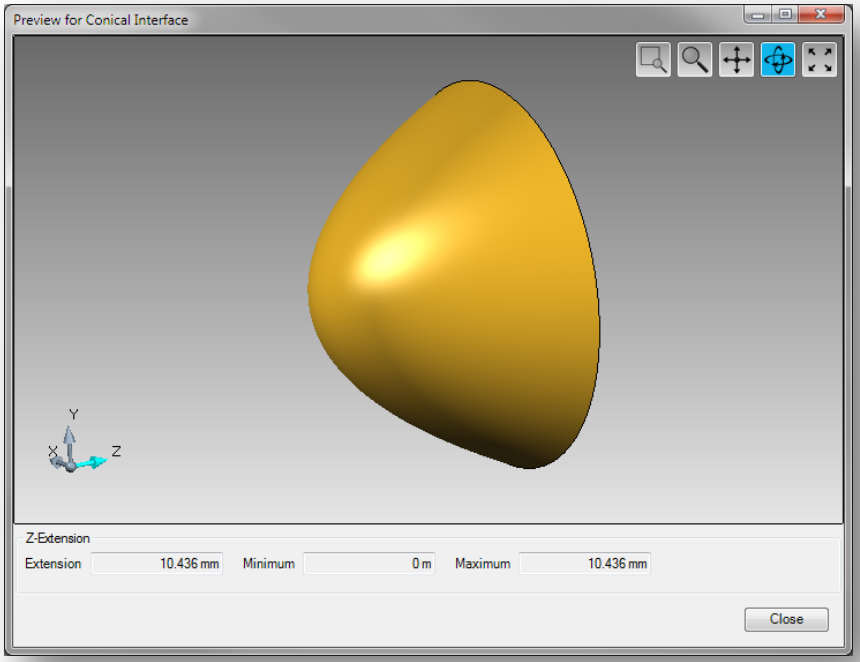


- The profile height can be scaled by a factor, the corresponding dialog entry is named *Scaling in z-Direction*.
- Formulas are given in the manual.

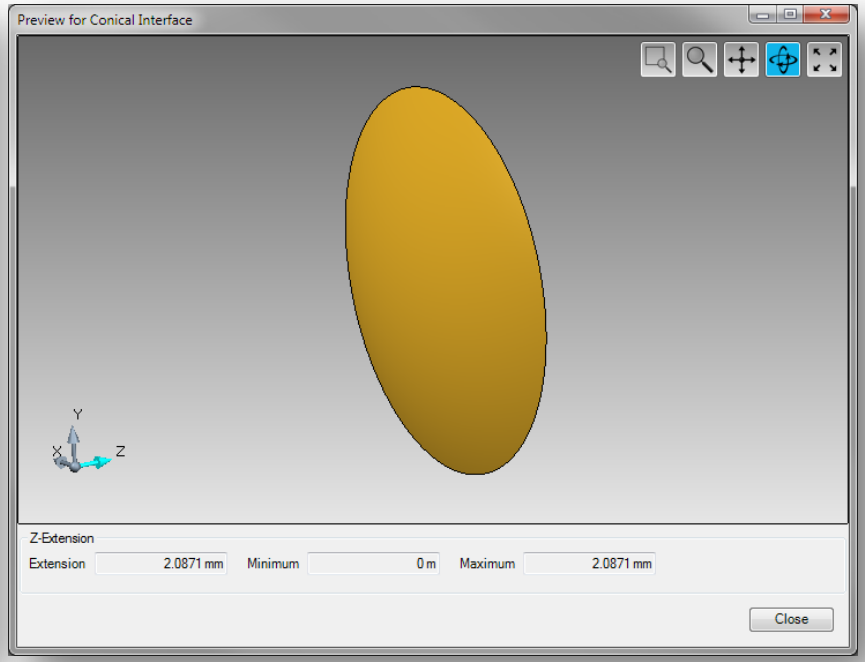
Results in

Scaling in z-Direction

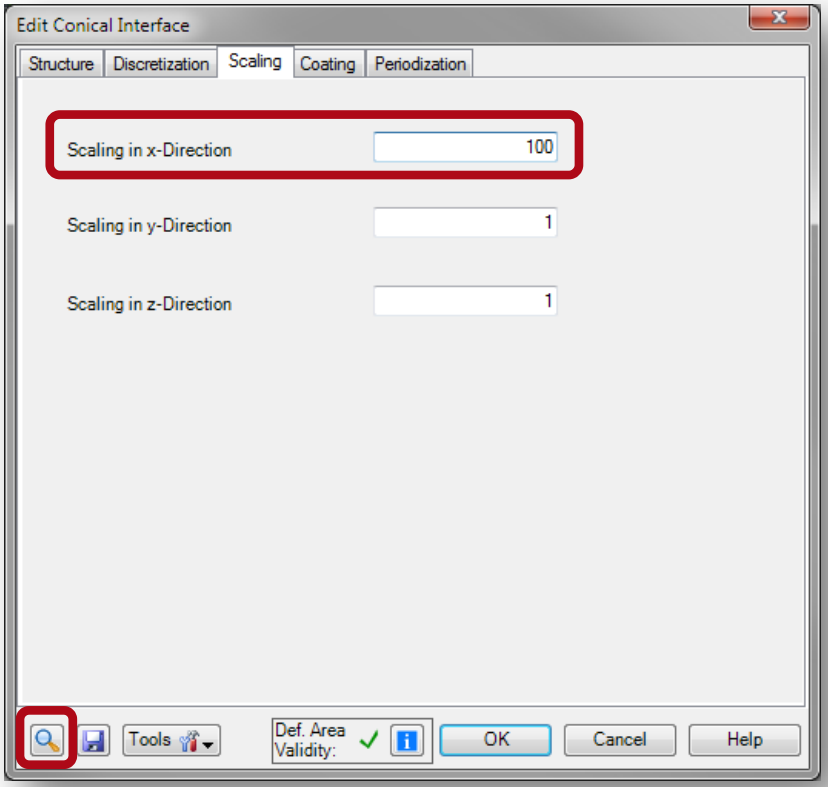
Scaling in z-direction with factor 5.



Surface profile without scaling.



Scaling in x(y)-Direction

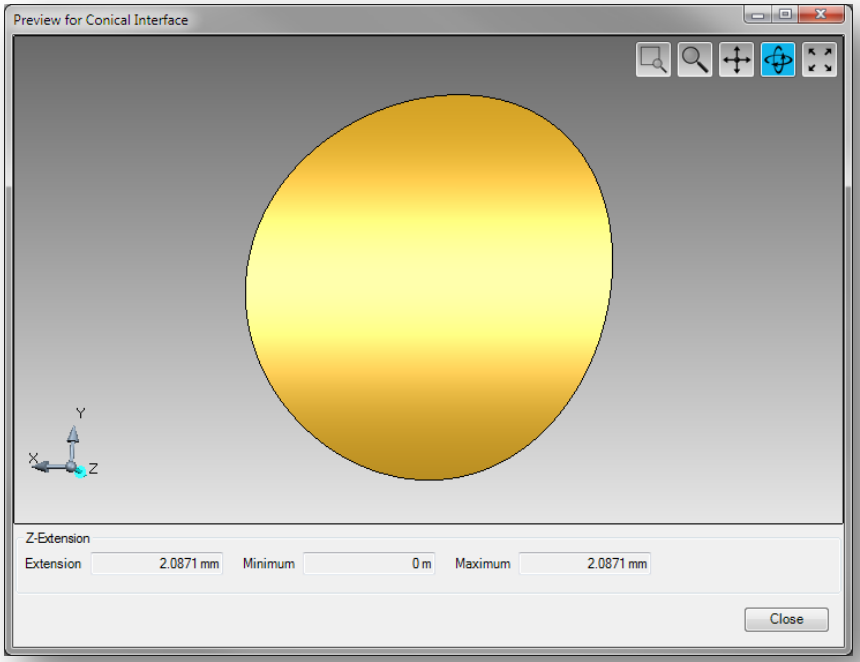


- The arguments (x,y) (coordinates) used within the profile height function can be scaled by a factor, i.e. scaling in x- or in y-direction.
- Formulas are given in the manual.

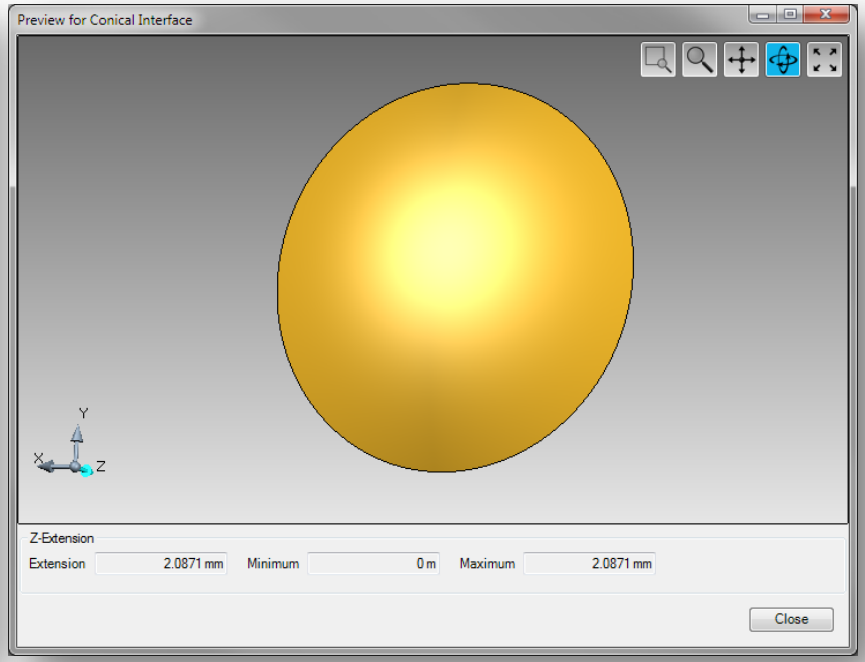
Results in

Scaling in x(y)-Direction

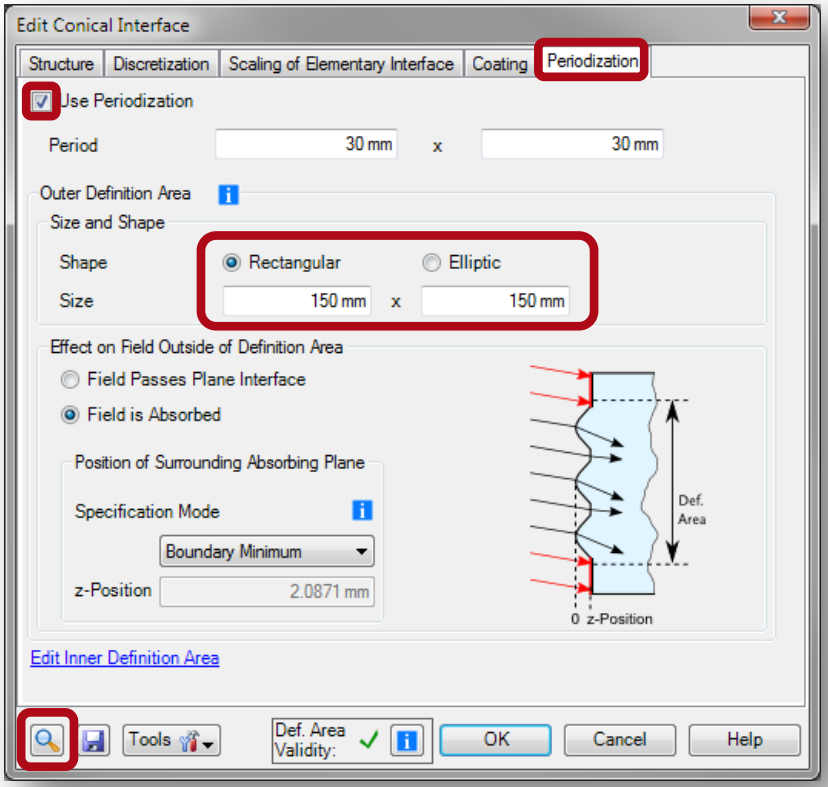
Scaling in x-direction (factor 100). The height is almost constant in x-direction.



All scaling factors = 1. Visible height modulation in x- and y-direction.



Periodization

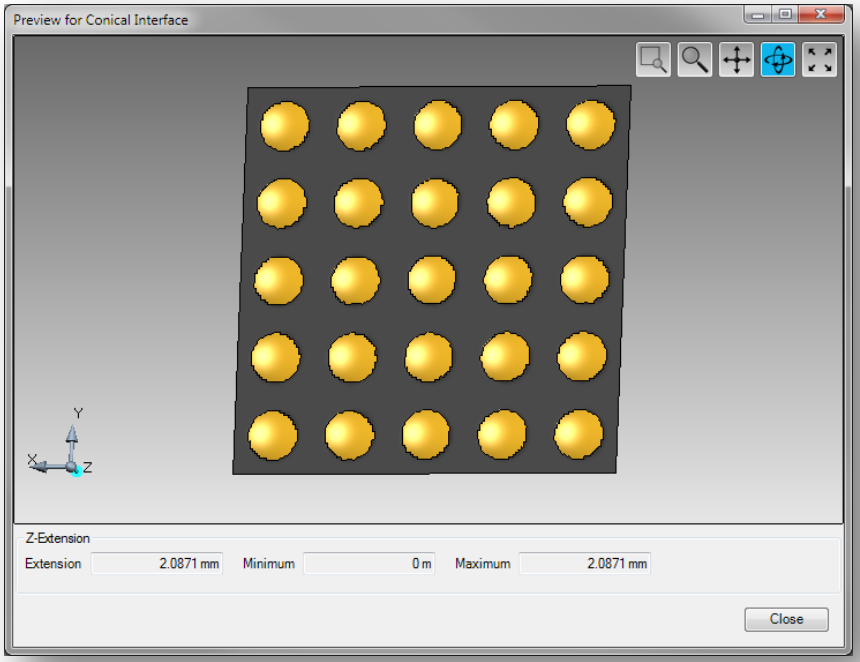


Periodization can be applied to all interfaces. Size of the period and size and shape of the outer definition area have to be defined.

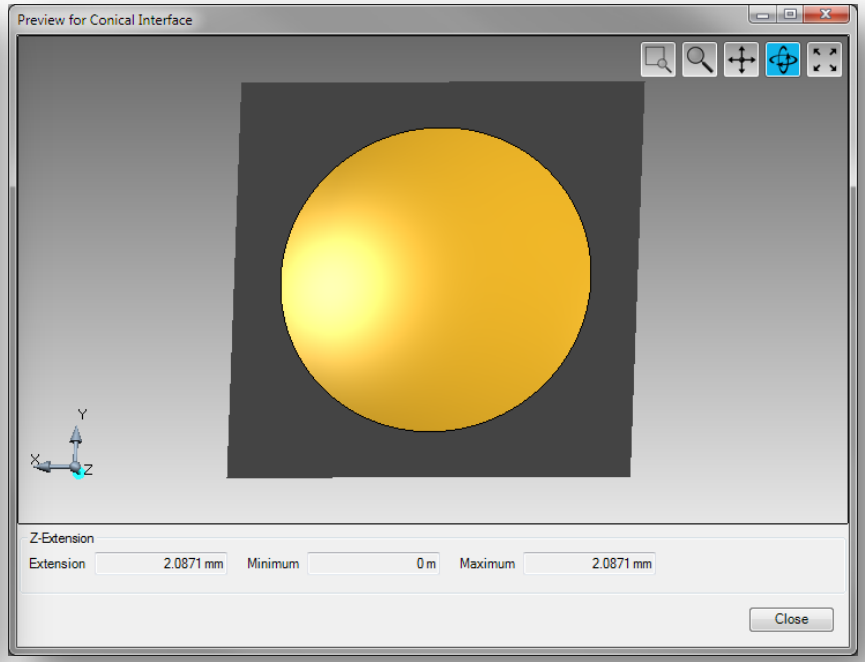
Results in

Periodization

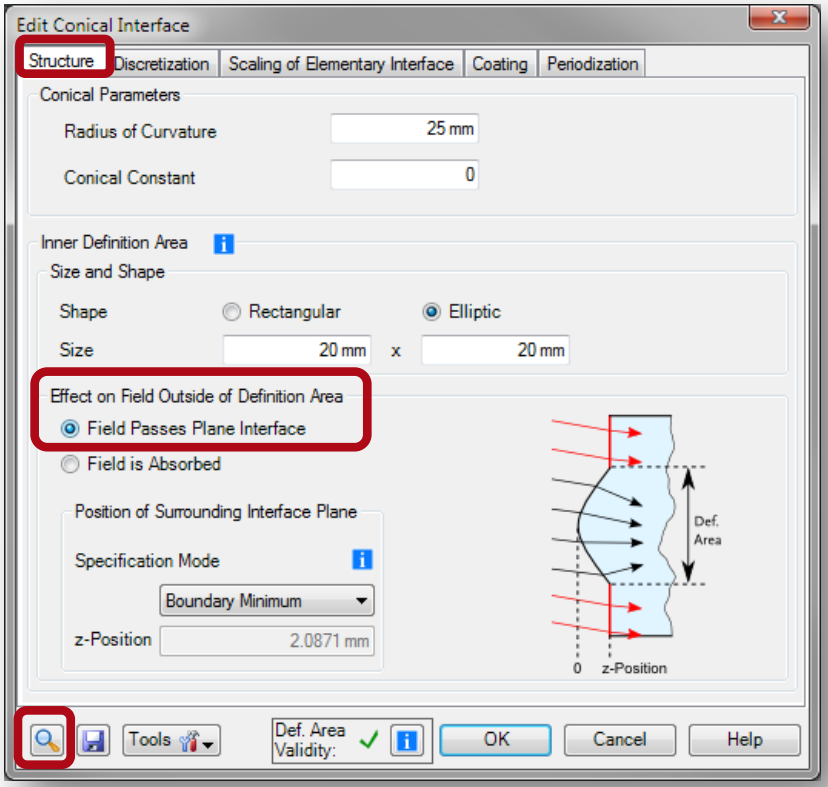
Periodic surface profile.



Single cell.



Inner Definition Area

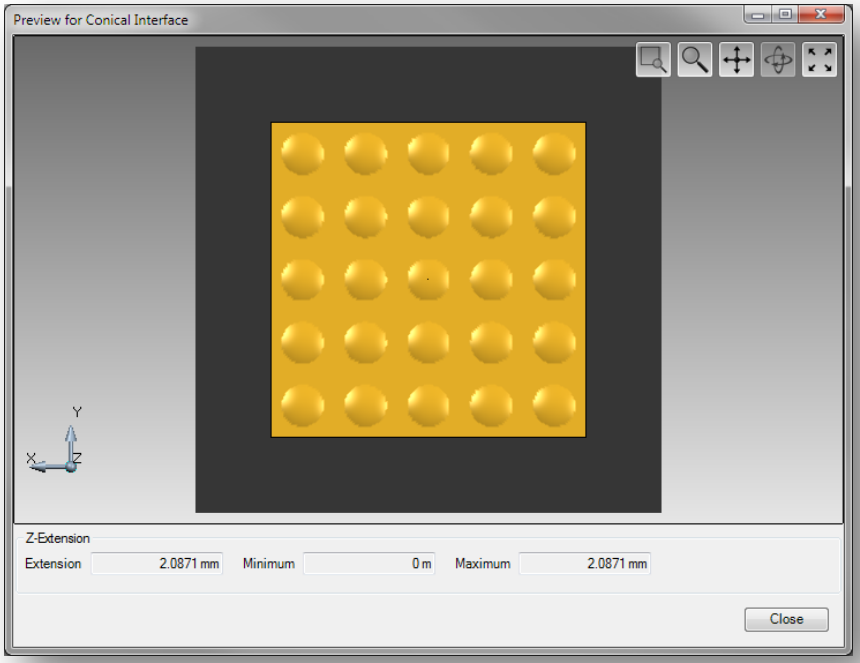


The field can pass the basic cell through a plane interface.

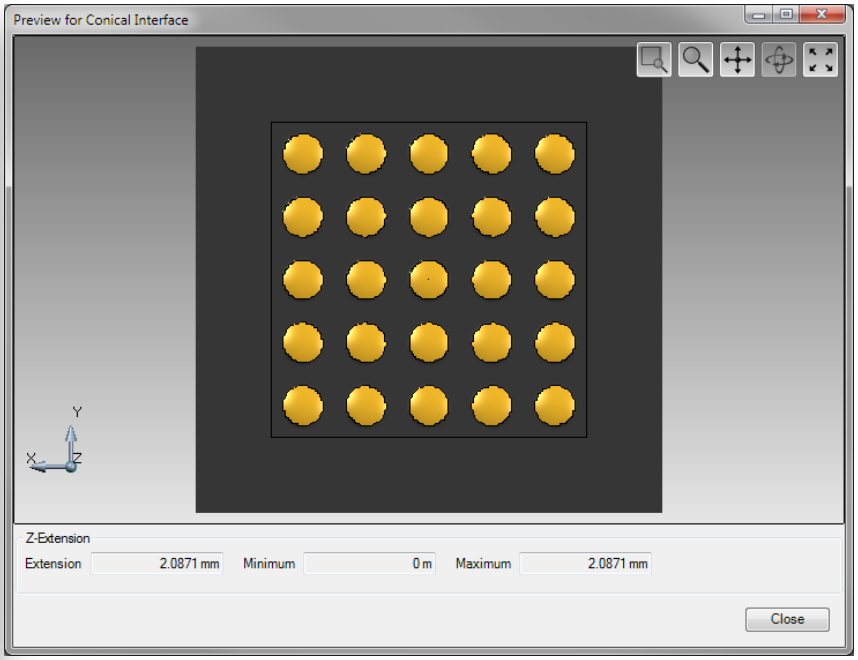
Results in

Inner Definition Area

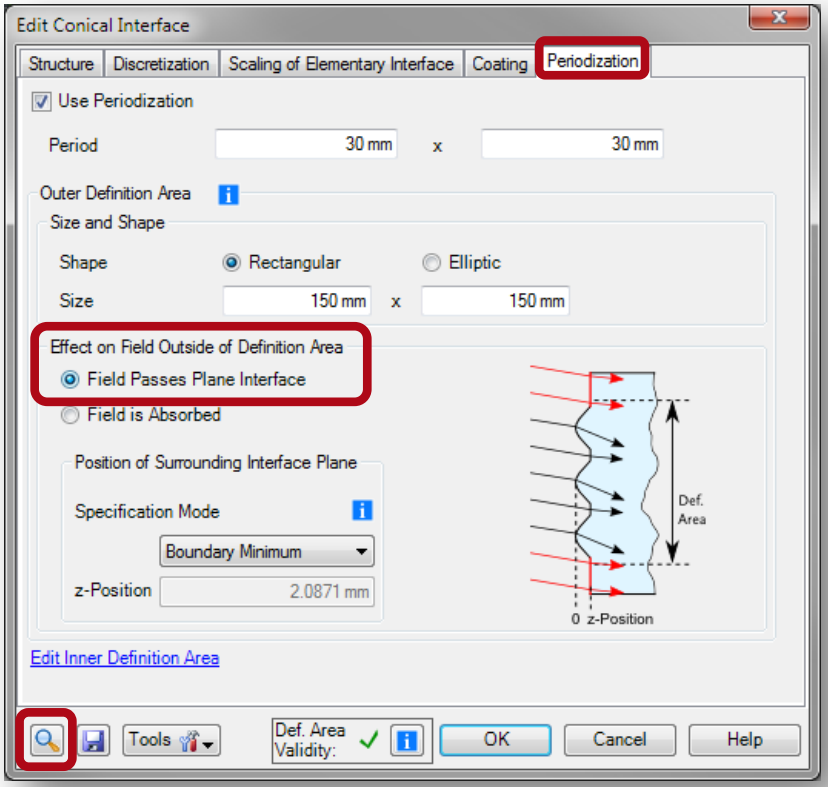
Field passes plane interface of inner cells.



Field is absorbed outside of inner definition area of inner cells.



Outer Definition Area

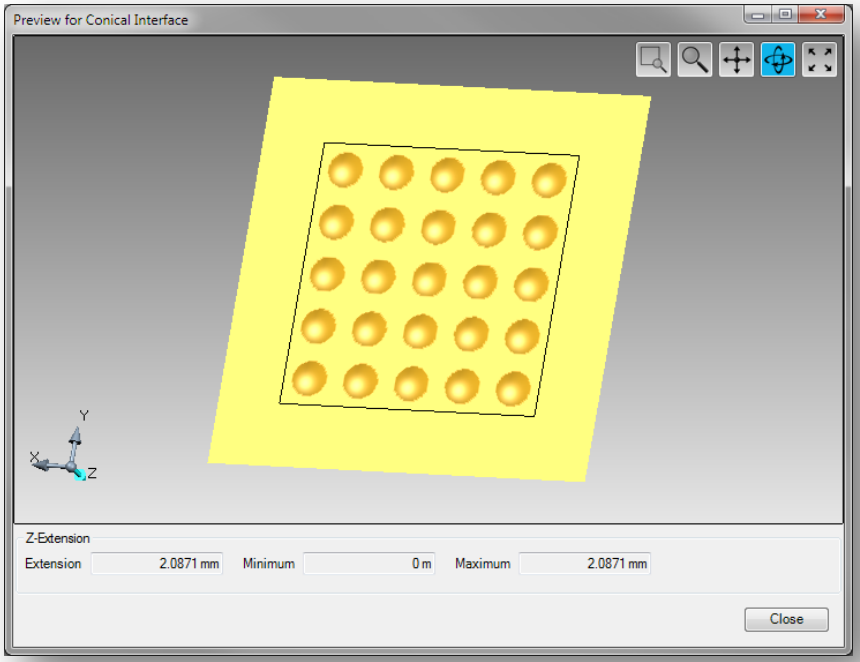


The field can pass the outer definition area through a plane interface.

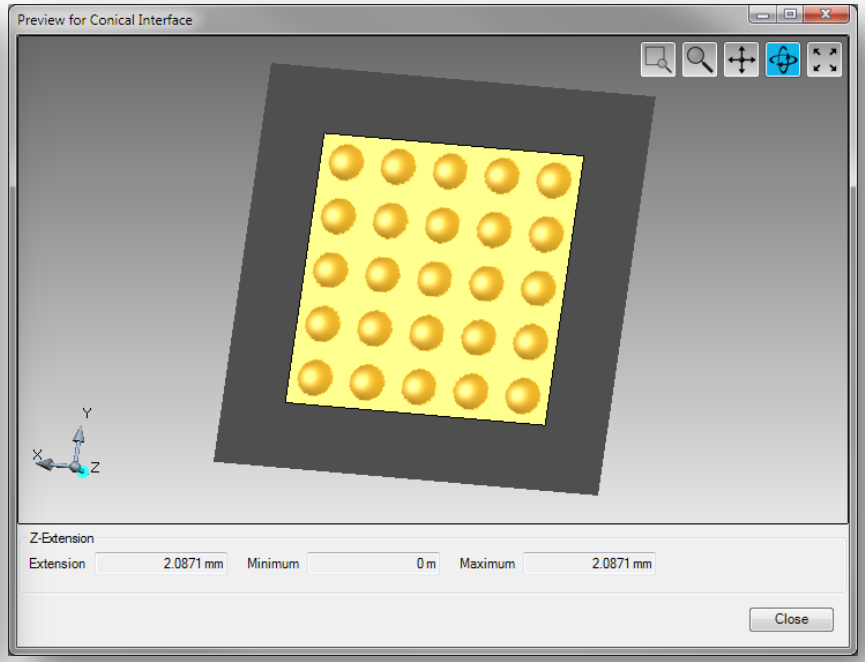
Results in

Outer Definition Area

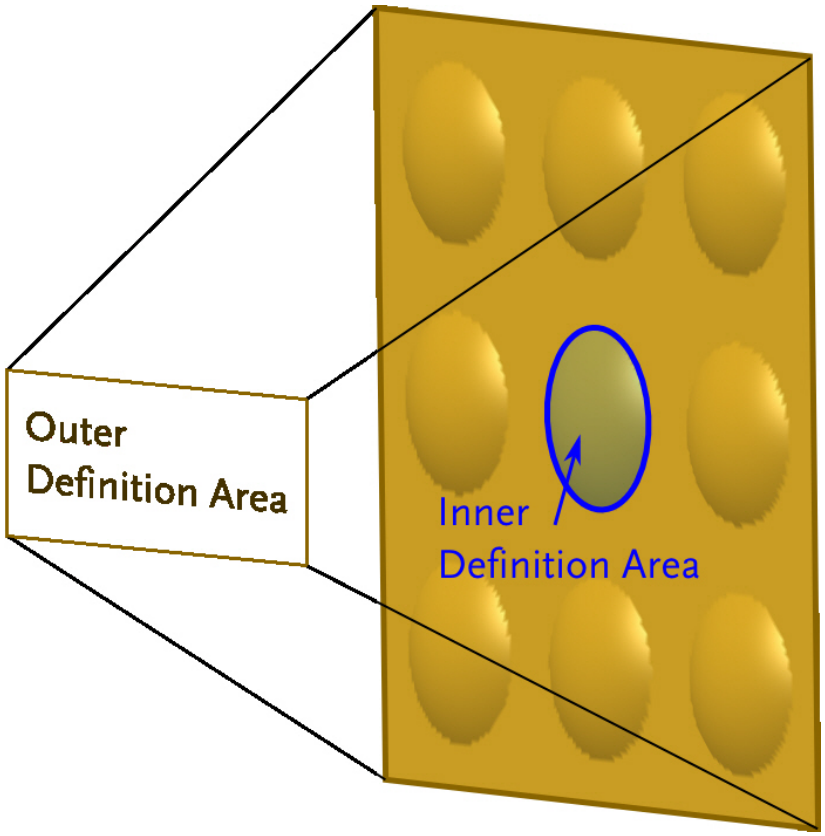
Field passes outer definition area through a plane.



Field is absorbed beyond outer definition area.

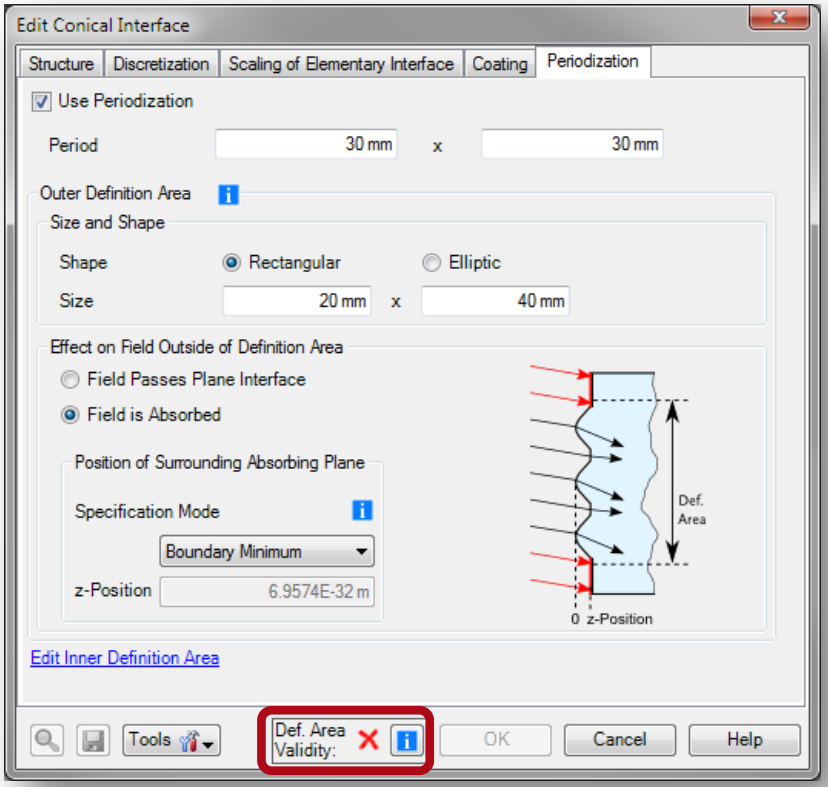


Restrictions in Case of Periodization



- The size of the inner definition area must not be larger than the size of the period.
- The size of the outer definition area must not be smaller than the size of the period.

Indication of Inconsistent Interface



- An inconsistent interface is indicated on the bottom of the interface dialog by a ×.
- If you click on the ⓘ-button a graph is displayed indicating the error (see next slide).

Indication of Inconsistent Interface