

Patterned Surfaces using Data Files and Adding Coating Layers

Products: RSoft CAD

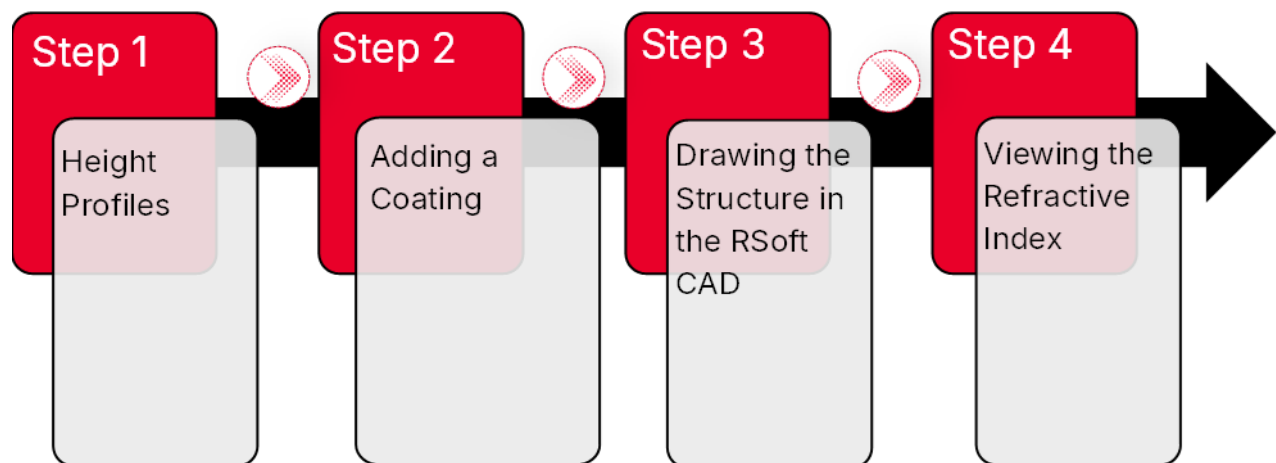
Applications: Nanophotonics and Nanostructures

Introduction

Many optical devices such as LED/OLEDs, DOEs (diffractive optical elements), and other patterned structures have complex or randomly textured surfaces. This type of surface can be defined in the RSoft CAD Environment using a simple ASCII file from either measured data (AFM, other) or a user-created file. This article will illustrate how to create such a surface, as well as add a conformal coating layer to the surface.

Flow Description

This workflow shows how to create realistic textured surfaces from measured or user-defined height profile data, add a conformal coating layer using the coatuf utility, construct the full structure in RSoft CAD, and visualize the resulting 2D and 3D refractive index distributions for verification.



Step 1: Height Profiles

A textured surface can be created in the RSoft CAD with a height profile, which can be an expression or data file that defines the height of a multilayer segment (typically measured along Y) as a function of X/Z. This example uses the sample AFM data in the file afm.dat plotted in Figure 1. The file is in a normalized coordinate system; the exact size of the texture will be set later in the RSoft CAD. Note that the final structure will be rotated so that the surface normal is along the Z-axis as shown in Figure 1.

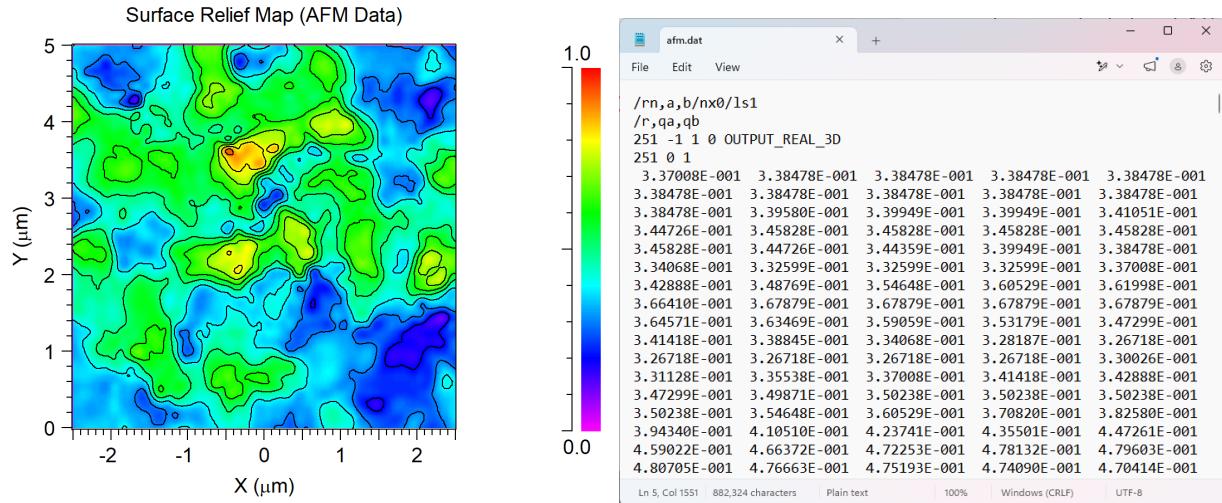


Figure 1. a) the surface relief map with original sample AFM data; b) AFM data file

Step 2: Adding a Coating

A coating can be added to a height profile surface by defining a second height profile with the desired surface height of the coating. This procedure is automated by the coatuf utility as illustrated in Figure 2.

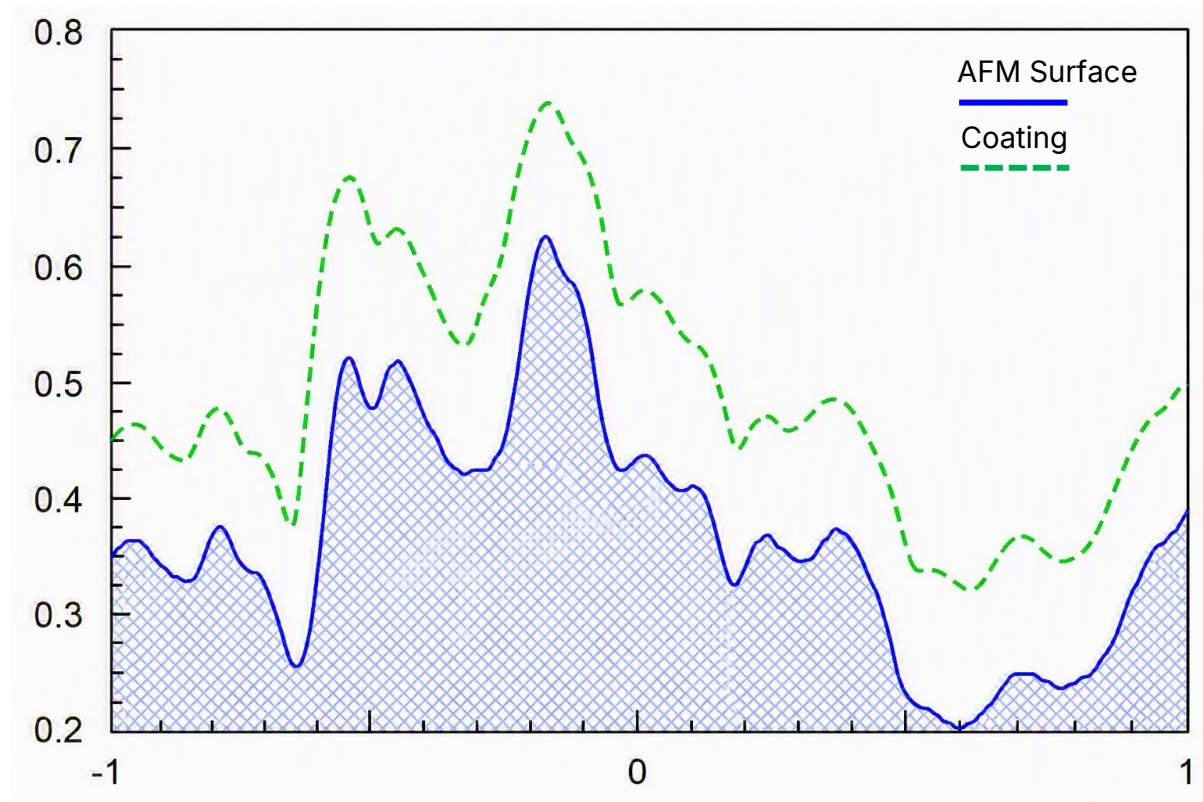


Figure 2. Illustration of coatuf utility adding one or more coating layers on a surface

For this example, we add a 0.1 μm thick coating with a refractive index of 1.5 to the top of the surface that was defined via the sample AFM data. The **coatuf** command used here is:

```
coatuf -t0.1 -sx2.5 -sy5 afm.dat afm_coat.dat
```

where **-t** sets the coating thickness and **-sx/-sy** sets the X/Y scaling factors needed to properly apply the coating in the normalized coordinates used in the data file. The new coating height profile is saved in the **afm_coat.dat** file. See Section E.F in the RSoft CAD manual for more detail about the **coatuf** utility

Step 3: Drawing the Structure in the RSoft CAD

This structure is created using three segments in the RSoft CAD as shown in Figure 3.

- 'Substrate' Segment (Red)
The red segment is a simple channel segment and represents the substrate. Its size is set by the symbols **Wtexture=5** (**Component Width: X size**) and **Htexture=5** (**Component Height: Y size**) which corresponds to the actual X/Y size of the texture. Its refractive index is 2.4 which is set by the symbol **Nsub**.
- 'Height Profile' Segment (Yellow)

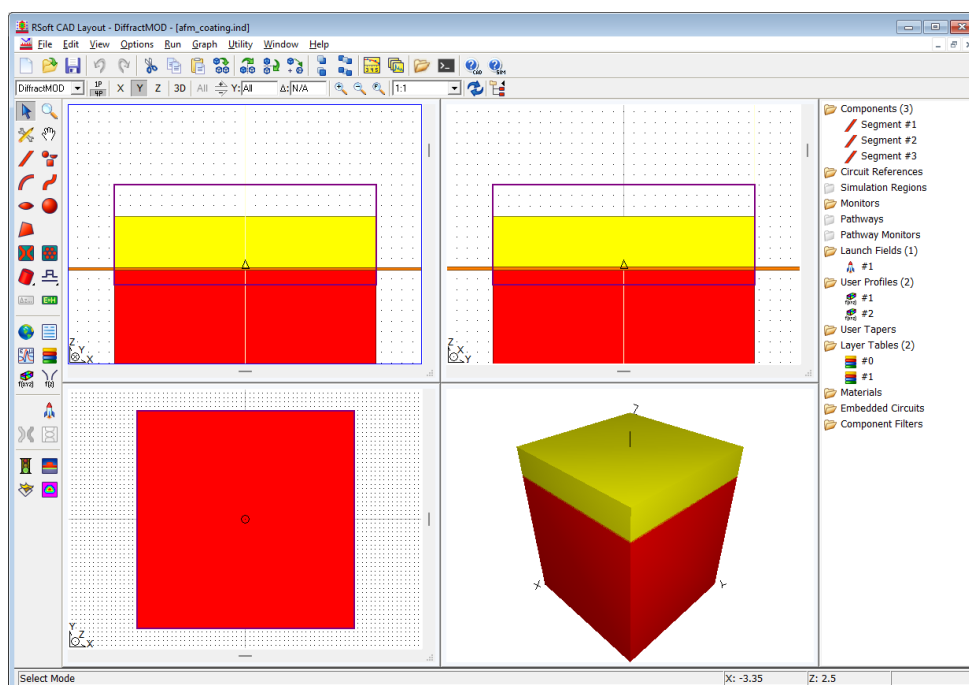


Figure 3. The structure as seen in the RSoft CAD. The yellow segment has the height profile defined and the red segment represents the substrate.

- The yellow segment is a multilayer segment and uses the User 1 height profile defined with the sample AFM data. This segment uses a Layer Table (#0) that has a single layer with a large height truncated by the height profile and a refractive index of 2.4 defined by the symbol Ntexture. The final height of each point is the component height multiplied by the data in the file. Normally multilayer segments are defined in the XZ plane and the height is measured along Y. This segment is rotated by -90 degrees with Seg Extended in Segment Orientation setting and -90 degree value for Reference Theta in the Additional Component Properties dialog box. In this way, the 'height' axis is rotated to along the Z-axis. The segment rotation changes the definition of the Component Height and segment length. Specifically, the 'length' sets the size along Y (Htexture=5um) and the 'height' size along Z (Ttexture=1um).
- Coating Segment (Light Cyan)

This segment has the same setting as the yellow segment except that the height profile is defined as User 2 with the data file afm_coat.dat; Layer Table (#1) is set with the refractive index of the layer using the symbol Ncoat=1.5.

Step 4: Viewing the Refractive Index

Click the Compute Material Profile button to view the refractive index profile of this structure. The results for the XZ plane and 3D Volume are shown in Figure 4.

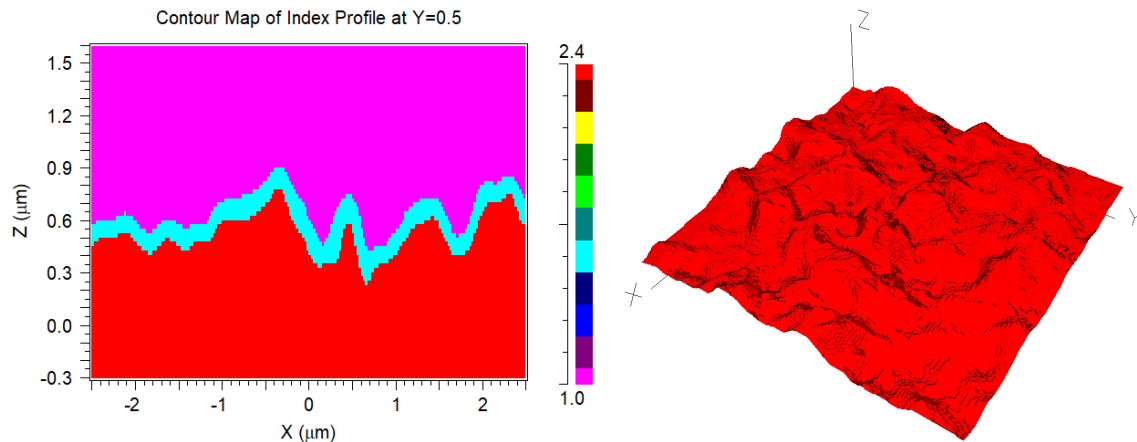


Figure 4. The resulting refractive index profile: a) in the XZ plane, and b) 3D Volume.

You can see that the random textured surface is created along Z-axis with a uniform coating on top of it.

Conclusion

This example demonstrates an efficient workflow for creating realistic textured surfaces from height profile data, automatically generating conformal coating layers, and visualizing the resulting refractive index distribution in RSoft CAD for accurate structure verification and design analysis.

Example files

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References

Keysight Optical Solutions RSoft CAD Layout User Guide

- RSoft CAD Layout » Appendix E Utilities » coatuf – Create Coating for User Profile