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Formation of sub-wavelength structures on organic materials by plasma-etching

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Reducing the reflected light in optical systems represents one of the basic aims of photonics. Reflected light causes losses to the intensity of transmitted light and can generate ghost images and stray light. To reduce these aberrations, interference multilayers are typically used. The application of sub-wavelength structures represents an alternative approach. AR nanostructures can be produced by plasma etching of polymer substrates but also by etching further organic materials. The vacuum deposition and etching of organic layers enables complex coatings consisting of several nanostructured layers or of combinations of nanostructured layers with multilayer interference stacks. An essential step to achieve a desired nanostructure is the deposition of an “initial layer” prior to the etching step. Manifold structures can be produced by varying the material and thickness of the initial layer. A useful initial layer is an about 1-2 nm thick titania layer deposited by evaporation. The layer is probably nearly but not completely closed after deposition, but it initiates the inhomogeneous ablation of the organic material that leads to structure formation. No structure formation takes place if a critical thickness is exceeded. The growth of the initial layer is also influenced by the surface roughness and the surface energy of the organic layer. Since the initial layer itself is not visible and hardly to detect, the plasmon band of an additional silver layer was used to visualize the effects of plasma surface treatment before starting the deposition of the initial layer. Nanostructure formation by applying initial layers and etching has been studied on cycloolefine polymer substrate and on vapor deposited organic layers.

Keywords
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