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Plasma-etching of biomaterials to produce nanostructures with low refractive index

Ulrike Schulz, Lisa-Marija Ahrens, Heiko Knopf, Peter Munzert, Tina Seifert, Norbert Kaiser

Fraunhofer IOF, Jena, Germany

ulrike.schulz@iof.fraunhofer.de

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 reflectivity, interference multilayers are typically used. The application of nanostructures with low refractive index represents an improved approach to realize antireflective (AR) properties. Nanostructured layers can be generated by plasma etching of organic materials. Only a few materials have been found yet which show the formation of a bumpy structure by etching without initial layer deposition. Especially, these “self-organized” nanostructures provide a well-controllable effective refractive index below 1.2 and a thin-film thickness higher than 100nm which is promising for broadband AR coatings. Aim of this work was to evaluate several biomaterials regarding their ability to form suitable nanostructured layers for AR. In a first part, materials directly provided by microorganisms were used. Optical characterization and etching experiments have been carried out on microbial polysaccharides (MPS) and on bacterial nanocellulose (BNC). Nanostructures with antireflection effect in the near-infrared region (NIR) could be achieved on MPS and BNC.
In a second part of work, nucleobases like Uracil, Thymine and further biomolecules were investigated regarding there usability for thermal evaporation and structure formation. Uracil has been identified to form bump structures in a self-organized way. The development of the structure was studied by using Scanning Electron Microscopy and optical spectroscopy. A nanostructured Uracil layer has been applied as the last layer of an AR coating to demonstrate the improved antireflection function in comparison to commonly used inorganic AR coatings.

Keywords
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