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Biosourced photoresist for Deep-UV photolithography

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ABSTRACT:

Industrial resists and solvents for their synthesis are known for their toxicity and destructive influence on the environment. The new tendency in the industry is to switch to bio-sourced resists and eco-responsible processes[1,2]. Biosourced polymers are great candidates to replace industrial resists as they are non-toxic, water-soluble and biodegradable. In this study we focus on chitosan, which being uncommon in nature, is generally prepared by deacetylation of chitin, the second most abundant biopolymer on Earth after cellulose. Chitosan is a linear copolymer composed of monomeric units of D-glucosamine (or 2-amino-2-deoxy-D-glucopyranose) and N-acetyl-D-glucosamine (or 2-acetamido-2-deoxy-D-glucopyranose) These monomers are linked together by β-(1-4) glycosidic bonds.
This polysaccharide has a good potential since it forms homogeneous films that adhere well to the substrate. Moreover, it is intrinsically photosensitive under Deep-UV light (at 193 nm). Consequently, photopatterning can be achieved without any chemical modification of the polymer and development can be achieved by use of deionized water.
Different techniques were used to investigate the interaction of chitosan and deep-UV, such as: FTIR spectroscopy, XPS, ToF-SIMS, ellipsometry and SEC analysis. Based on these results we proposed a mechanism to explain the solubility change upon the irradiation which enables photopatterning on the polymer film.
Chitosan-based resist allows one to obtain micrometric features and followed by etching step shows its potential to be used in photolithography-based processes.
Examples of the patterns and etched structures are given in Fig. 1.

Figure 1 : Molecular structure of chitosan, examples of patterns obtained by DUV photolithography and after transfer by reactive ion etching (AFM).