Photocurable Silsesquioxane Resist Materials for Nanoimprint Lithography

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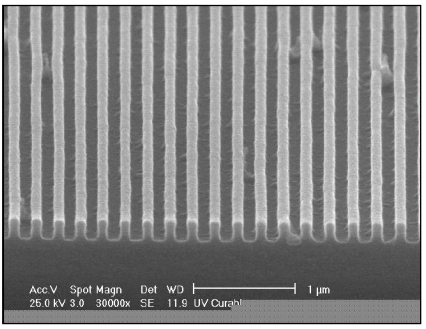

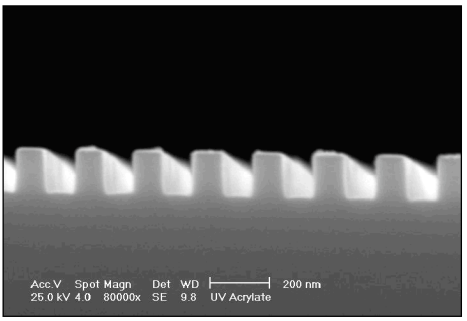

120nm linewidth dense grating imprinted in epoxy-based SSQ resin, and pattern transferred into oxide by using the imprinted SSQ template as a dry etching mask.

Photocurable silsesquioxane (SSQ) polymers are being developed as future resist systems for nanoimprint lithography (NIL), a technique that promises high-throughput nanoscale replication with great precision and resolution. The research for new resist materials is fundamental for the success of NIL as a next-generation lithographic technique. In contrast to the commonly used thermoplastic polymeric resist, photocurable SSQ's can be imprinted within seconds or shorter time at room temperature so the replicated pattern is not subject to mechanical distortions during a typical heating-cooling step. Moreover, the viscosity of the polymeric precursor can be easily adjusted such that only low pressure (<50psi) is needed during the imprinting process. The imprinting results revealed that the developed silsesquioxane resins are appropriate materials for nanoscale patterning. These polymers present outstanding properties such as a high modulus (in the order of GPa) and high thermal stability. The high modulus allows the replication of nano-features with high fidelity and avoids the lateral collapsing of the imprinted lines. Dense gratings with linewidth down to 70nm and an aspect ratio of 2.7:1 have been achieved. Due to their high silicon content, the synthesized SSQ's also showed appropriate plasma etching characteristics, making these materials suitable as etch mask for pattern transferring directly into substrates such as SiO_2.
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