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Nanoimprint Stamps with Ultra-High Resolution: Optimal Fabrication Techniques

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Highlights:

- Single-step replication from negative master stamp as optimum strategy
- Stamp feature size reduction by ALD
- Imprint with 5.6 nm resolution with OrmoStamp
- Pattern transfer of 20 nm features to silicon oxide layer

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ABSTRACT

Single-digit nanometer patterning by nanoimprint lithography is a challenging task, which requires optimum stamp fabrication technique. In the current work, we present different strategies for technology of hard master stamps to make intermediate working stamps with sub-10 nm features. Methods of both negative and positive master stamps fabrication, based on EBL, RIE and ALD are described and compared. A single-step copying of negative master stamps using a polymer material is a preferred strategy to reach the ultra high-resolution. Lines as small as 5.6 nm are demonstrated in a resist using a combined thermal and UV-imprint with OrmoStamp material as a working stamp.

1.0 Introduction

Methods of single-digit nanofabrication, i.e. the technology for fabricating nanostructures with typical feature sizes below 10 nm, represent a very rapidly developing field of nanotechnology, both for fundamental research and for industrial applications. They include different high-resolution lithographic methods and can be classified in two inherently different strategies: top-down and bottom-up techniques. The first, top-down approach, is well-developed, and represented by such methods as electron beam lithography (EBL) [1], focussed ion beams (FIB) [2], scanning probe writing [3] and recently nanoimprint