Faculty of Electrical Engineering & Computer Science
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HOCHSCHULE BREMEN
UNIVERSITY OF APPLIED SCIENCES

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Sebastian Habenicht

Fabrication and Characterisation of Shallow Ridge Silicon Photonic Waveguides

ABSTRACT - Masterthesis

Within this thesis a thermal oxidation fabrication technique is employed to form low-loss high-index-contrast silicon shallow-ridge waveguides in silicon-on-insulator (SOI) with maximally tight vertical confinement.

A well described photolithography process for patterning silicon nitride (Si_3N_4) with photoresist is presented, followed by different techniques to transfer the pattern from the photoresist into the underneath Si_3N_4 and silicon dioxide or also known as oxide ($Si0_2$) layer, which both act as hardmask for the thermal oxidation process. All relevant etch rate values for low-pressure chemical vapor deposition (LPCVD) Si_3N_4, plasma-enhanced chemical vapor deposition (PECVD) $Si0_2$ and AZ5206E photoresist are discussed for reactive ion etching (RIE), and buffered hydrogen fluoride (BHF) or hydrogen fluoride (HF) etched samples.

Extensive microstructural characterisation of the root mean square (RMS) surface roughness profile for different fabricated samples are provided to show the research aim of getting silicon shallow-ridge waveguides with RMS surface roughness of around 0.2 nm, which is as smooth as a highly polished silicon wafer before any processing. The attained value is an order of magnitude less than that typically obtained with conventional etching processes.