Fabrication of high aspect ratio TiO$_2$ and Al$_2$O$_3$ nanogratings by atomic layer deposition - DTU Orbit (28/12/2018)

**Fabrication of high aspect ratio TiO$_2$ and Al$_2$O$_3$ nanogratings by atomic layer deposition**

The authors report on the fabrication of TiO$_2$ and Al$_2$O$_3$ nanostructured gratings with an aspect ratio of up to 50. The gratings were made by a combination of atomic layer deposition (ALD) and dry etch techniques. The workflow included fabrication of a Si template using deep reactive ion etching followed by ALD of TiO$_2$ or Al$_2$O$_3$. Then, the template was etched away using SF$_6$ in an inductively coupled plasma tool, which resulted in the formation of isolated ALD coatings, thereby achieving high aspect ratio grating structures. SF$_6$ plasma removes silicon selectively without any observable influence on TiO$_2$ or Al$_2$O$_3$, thus revealing high selectivity throughout the fabrication. Scanning electron microscopy was used to analyze every fabrication step. Due to nonreleased stress in the ALD coatings, the top parts of the gratings were observed to bend inward as the Si template was removed, thus resulting in a gradual change in the pitch value of the structures. The pitch on top of the gratings is 400 nm, and it gradually reduces to 200 nm at the bottom. The form of the bending can be reshaped by Ar$^+$ ion beam etching. The chemical purity of the ALD grown materials was analyzed by x-ray photoelectron spectroscopy. The approach presented opens the possibility to fabricate high quality optical metamaterials and functional nanostructures.

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