Conformality of spatial atomic layer deposition of AlO_x

Short description: Spatial atomic layer deposition (ALD) is an effective method for processing nanomaterials for low cost, high volume applications because of its high throughput. In order to use this technique for more challenging applications, like batteries, it is essential to be able to deposit conformal films inside high aspect ratio substrates. In this project, you will study the conformality of AlO_x films deposited by spatial ALD.

Background: ALD is a ground-up material processing technique, characteristic for depositing uniform and conformal films with exceptional thickness control. In temporal (conventional) ALD, precursor and reactant are separated in time by alternatingly dosing them, separated by a purge step. On the other hand, in spatial ALD, precursor and reactant are separated in space (**Error! Reference source not found.**), allowing for significantly faster depositions. For example, growing 100 nm of AlOx on our tool takes less than 10 min, where it would take several hours on a temporal ALD tool.

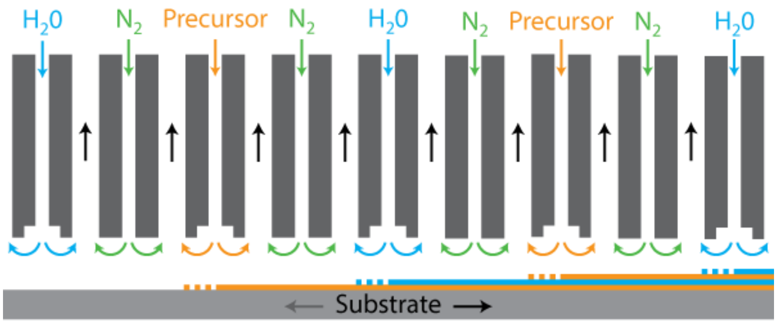

Figure 2. Deposition head of our spatial ALD tool, consisting of precursor, reactant (H_2O) and N_2 slits, separated by exhaust slits. The substrate passes sideways under the head, where each pass corresponds to two ALD cycles.

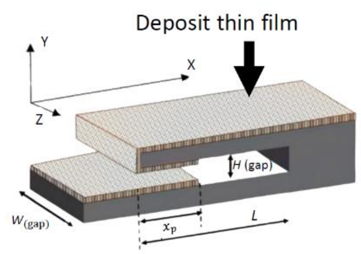

Figure 1. Schematic view of a PillarHall lateral high aspect ratio structure. Films can be deposited inside the lateral trench and analyzed after removing the top membrane.

Project: In this project, you will investigate the conformality of spatial ALD AlO_x in high aspect ratio structures. For this we use PillarHall chips which contain lateral trenches (Figure 2). You will start off by optimizing the AlO_x process on our spatial ALD tool, before continuing with the conformality study. Some of the analysis techniques you will use are spectroscopic ellipsometry (SE), reflectometry, and X-ray photoelectron spectroscopy (XPS). After the conformality study of AlO_x, if time allows it, you can move to a more complex material, like aluminum-doped zinc oxide (AZO).

Location and supervision: This research is part of the Plasma & Materials Processing group, located on the 3rd floor of Flux. You will perform the experimental work in both the main lab of the group (de labtuin) and the NanoLab cleanroom, located on the ground and 1st floor of Spectrum, respectively. Mike van de Poll will act as your daily supervisor and additional supervision will be provided by Bart Macco.

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