Low-energy ion sputtering for atomic layer etching and surface cleaning

Short description: A metal oxide or chemically modified layer will be etched from its substrate by plasma-generated low-energy ions.

Background: To enable further downscaling of microchips according to Moore's law, new fabrication schemes are emerging in the semiconductor industry, such as atomic layer etching (ALE). ALE can remove materials with atomic-layer precision and sometimes uses low-energy ion sputtering. Low-energy ion sputtering can also be used on its own to clean surfaces after certain fabrication steps. The development of these processes can be aided by a deeper understanding of how ion sputtering works at the interface of two materials.

Ion sputtering has both a chemical and physical component. When an ion impinges on the surface of a material, a series of (almost) elastic collisions with the atoms in that material follows, see also Fig. 1. Energy and momentum is transferred from the ion to these atoms in this so-called collision cascade. If a surface atom gains upwards momentum and a kinetic energy larger than its chemical binding energy, it will leave the surface. Both the collision cascade and the binding energy can depend on the combination of top layer and underlaying material.

Project: The focus of this project is on ion sputtering of a very thin metal oxide layer (< 1 nm) or a chemically modified top layer. Using low-energy ions, this thin layer will be (partly) removed. The behavior of the ion sputtering will be investigated using spectroscopic ellipsometry and X-ray photoelectron spectroscopy.

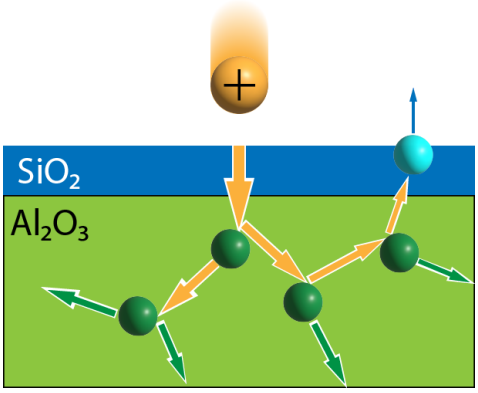

Fig. 1: *Schematic illustration of a collision cascade at the interface of two materials.*

If interested please contact:

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Location and supervision: You will perform experiments in the cleanroom that is located in spectrum. You will be supervised by Arthur de Jong and Adrie Mackus.