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MASTER

Developing Atomic Layer Etching Processes for Ternary Materials

Salij, Jörgen A.C.R.M.

Award date:
2023

Link to publication

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Abstract

A move towards more powerful and intricate devices in the semiconductor industry is creating a push towards the use of, and research into, more complex materials. This work investigates atomic layer etching (ALE) of ternary materials, materials with three different elements. In the first part, the mechanisms which can be employed to achieve a self-limiting half-reaction were investigated. A typical ALE process modifies the surface in the first half-cycle before removing the modified layer in the second half-cycle. In this work, a new approach for ALE of ternary materials is introduced.

In the second part, ALE chemistries were tested experimentally for AlGaN and SiφAl1–φOw by making use of the defined self-limitation mechanisms. A process was developed for AlGaN using modification and removal mechanisms using an SF_6-plasma and TMA. SiφAl1–φOw is used as a model system for the novel ALE approach. Evaluation of the etch rate as a function of the Si-content in the film, two regimes were identified. While more research is required, the newly developed approach to ALE was found to be a promising candidate for ternary materials.