Semiconductor Technology from A to Z

Oxidation

Overview

Application of Oxide Layers

Oxide is used in semiconductor manufacturing in a wide variety of fields:

- for isolation (e.g. between metallization layers)
- as a scatter layer (e.g. ion implantation)
- as an adaptation layer (e.g. LOCOS technique)
- for planarization (e.g. to soften edges)
- as a masking layer (e.g. diffusion)
- as alignment marks (alignment points in photolithography)
- as a protective layer (against mechanical damage)

Properties of oxide layers

In combination with silicon, oxide appears as silicon dioxide (SiO_2). It can be deposited on the wafer in very thin, highly uniform layers.

SiO_2 is very resistant and in semiconductor manufacturing can only be wet-etched by hydrofluoric acid (HF). Water and other acids do not attack the oxide; due to the risk of contamination by metal ions, alkaline solutions (KOH, NaOH, etc.) cannot be used. These, however, play a role in micromechanics for anisotropic wet etching – there they attack the silicon while the oxide remains virtually untouched, which is exactly why it serves as a mask. The removal process with HF proceeds according to the following reaction:

$SiO_2 + 6HF \rightarrow H_2SiF_6 + 2H_2O$

Furthermore, oxide is well suited for circuit functions, as it meets a wide variety of requirements (e.g. as gate oxide, field oxide, or interlayer dielectric).

What matters here is less the oxide itself than the interface to the silicon. It can be thermally grown with such a low defect density that a transistor switches reliably across it. No other semiconductor has its own oxide with this property – this is the main reason why silicon has prevailed over materials that would actually be more favorable electrically.