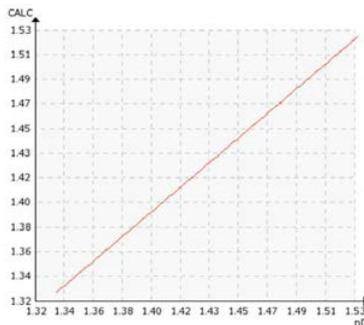


HYDROFLUORIC ACID (HF), DEIONIZED WATER (DIW), SC-1 (H₂O₂, NH₃)

Typical end products

Silicon wafers.

Chemical curve: R.I. per Conc% b.w. at Ref. Temp. of 20°C



Introduction

Cleaning chemicals are the most consumed liquids in a fab. These include acids and bases to remove organic and inorganic contaminant residues from the wafers. The most commonly used cleaning solutions are *standard clean 1* (SC-1) and *standard clean 2* (SC-2). If the wafers are particularly contaminated, there are additional cleaning steps utilizing a solution known as *Caros* or *Piranha* and diluted hydrofluoric acid (DHF).

Thorough rinsing with deionized water (DIW) is required after each chemical step. This is usually followed by a spin dry process.

Common tools for wafer cleaning are immersion baths and single wafer spray systems. Centrifugal spray

units offer benefits over immersion baths since each wafer is uniformly exposed to uncontaminated, fresh chemicals.

Application

The spray acid chamber is designed to allow multiple chemicals to be applied on the wafer in-situ through a nozzle or dispenser, providing tight control while eliminating the risk of contamination.

HF and SC-1 are common chemicals used for wafer cleaning. The chemicals are delivered separately with a DIW rinse between steps. These solutions are provided at certain preferred temperatures, in a particular sequence and manner. The time span for each step is only tens of seconds.

In order to maintain a continuous flow, the interface between the liquids should be monitored. Vaisala K-PATENTS® Semicon Refractometer PR-33-S allows for instant switching between cleaning chemicals and DIW by means of refractive index measurement (Figure 1).

Refractive index is an inherent property of all liquids and is unique for each chemical. The refractometer immediately detects the liquid in the line and sends a signal to the PLC to open and close valves and divert the flow as required. This ensures the correct chemical is dispensed and prevents mixing between liquids.

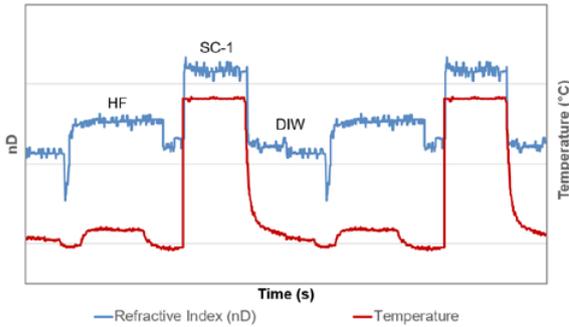


Figure 1. Example of interface detection between wafer washing steps with the refractometer.

Instrumentation and installation

The Semicon Refractometer PR-33-S is mounted as an integrated device in the cleaning tools. The refractometer provides Ethernet and 4-20 mA output

signals that can be connected to the process controller for continuous and accurate control.

Set-points based on the refractive index values of the cleaning chemicals and DIW can be created to control the valves. The refractometer covers the full refractive index range nD of 1.32 to 1.53, with a measurement accuracy of $nD \pm 0.0002$.

Moreover, the refractometer has a built-in temperature sensor to measure the temperature of the surface in contact with the process liquid, providing fast and automatically temperature compensated reading. Typical temperature range in this application is 20-60 °C (68-140 °F).

Instrumentation	Description
	<p>A small footprint, PVDF covered sensor for cleanroom environment and integrated process tools. Monitors the chemical concentrations in real-time and provides an Ethernet output signal and immediate feedback to the control system. Connected through a modified PTFE flow cell body to the process by a 1/4"-1" Nippon pillar or flare fitting.</p>
Measurement range	Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 % by weight.