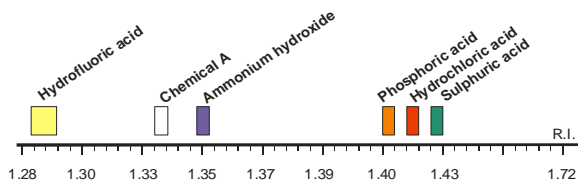


## PREVENTING INCORRECT CHEMICALS FROM ENTERING THE FAB PROCESS

### Typical end products

Semiconductors, integrated circuits, microprocessors, LEDs, LCD displays, silicon wafers

### Refractive Index of typical semiconductor chemicals:



### PROCESS

In-coming chemical quality is typically left to the chemical suppliers, and semiconductor fabricators have very limited capability to detect problems with process chemistries from their suppliers. Poor chemical quality is discovered through in line test data or poor e-sort performance. Changes that can occur during in-house handling are disregarded and not monitored. Furthermore, factors such as human error in container handling and equipment failure at the distribution point are not taken into account.

### APPLICATION

K-Patents refractometer prevents wrong bulk chemicals and wrong chemical concentrations from entering the process tools and this way helps to prevent expensive equipment damage and wafer scrap. The key control function in this application is to provide an alarm if the chemical is out of specifications. In many cases, the K-Patents Refractometer pays for itself when preventing one single mishap.

The Refractometer uses Refractive Index  $n_D$  as measurement principle. The benefit is that one sensor can detect all chemicals. Every chemical is unique in terms of the physical property of Refractive Index.

The standard K-Patents Refractometer covers the full Refractive Index  $n_D$  range of 1.32 to 1.53 (= corresponding to 0-100 %Conc.). This R.I. range can be extended by using Sapphire, YAG or GGG as prism material.

SEMICONDUCTOR INDUSTRY	
APPLICATION NOTE	5.00.10
BULK CHEMICAL DELIVERY SYSTEMS	

## INSTALLATION

The K-Patents Refractometer measures the concentration of process liquids such as KOH (Potassium hydroxide), H<sub>2</sub>SO<sub>4</sub> (Sulphuric acid), HF (Hydrofluoric acid), NH<sub>4</sub>OH (Ammonium hydroxide), HCl (Hydrochloric acid), IPA (Isopropyl alcohol), Ethylene glycol, and others. Also chemical mixtures known for example as SC-1, SC-2, SPM, DHF, etc. are measured. In multi-component solutions this is a checksum; if one of the components is wrong, the overall refractive index changes. The only chemical parameter that is not detectable via Refractive Index  $n_D$  is surfactant concentration, because surfactant concentrations e.g. for BHF and developers are only few part per million (ppm).

Depending on the brand and chemical distribution system, the ideal location and positioning for the Refractometer allows for the monitoring of chemical fed into the fab as well as drum changes.

The K-Patents Refractometer provides a continuous 4-20 mA or Ethernet measurement

signal. Shutdown set points are determined by the incoming chemical quality. Set points for the shutdown are set within the acceptable limits of the chemical. For example if the range of assay for Sulphuric acid is 95% to 98% the limits for the refractive index system can be 95.5% to 97.5 %.

Therefore the processes are truly protected from the material going out of specification. Shutdown of the distribution system occurs as the limit is approached, not violated, which is very similar to what a statistical process control program would do.

## SUMMARY

Implementation of K-Patents Refractometer is economically feasible (less than the cost of the labor to correct a major event). It should also be noted that expertise in the chemical distribution area should not be overlooked or underestimated. Instead this should be treated as a critical tool set capable of causing significant impacts to a fab very quickly.