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Article Author W. Kern and D. A. Puotinen

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This 20 page article discusses the original RCA clean, wafer contamination, the effectiveness of this clean and electrical device performance using this clean.

# Cleaning Solutions Based on Hydrogen Peroxide for use in Silicon Semiconductor Technology

**Werner Kern**

RCA Laboratories, Princeton, N. J.

**David A. Puotinen**

RCA Solid-State Division, Somerville, N. J.

**Abstract**—Hydrogen peroxide solutions at high  $pH$  are particularly effective for removing organic contaminants by oxidation; at low  $pH$  they are effective for desorbing metal contaminants primarily by complexing. The stability of these mixtures during usage and the effects of hydrogen peroxide depletion on the etching of silicon were measured as functions of resistivity type and doping concentration. These solutions are effective and simple to use, and have wide applications to the cleaning and preparation of silicon device wafers, quartz tubes, and implements employed in semiconductor processing.

### 3. New Cleaning Procedure

Two solutions, used sequentially, have been devised to remove any organic and inorganic contaminants remaining after solvent rinsing. Both solutions contain volatile reagents diluted with pure water. The exact compositions are not critical; some of the work discussed was done using slightly different compositions. However, the recommended compositions afford greater freedom in their application.

The first solution, typically 5-1-1 to 7-2-1 parts by volume of  $\text{H}_2\text{O}^*$ - $\text{H}_2\text{O}_2^\dagger$ - $\text{NH}_4\text{OH}^\ddagger$ , was designed to remove organic contaminants that are attacked by both the solvating action of the ammonium hydroxide and the powerful oxidizing action of the peroxide. The ammonium hydroxide also serves to complex some group I and II metals such as Cu, Ag, Ni, Co and Cd.

The second solution consist of  $\text{H}_2\text{O}^*$ - $\text{H}_2\text{O}_2^\dagger$ - $\text{HCl}^\ddagger$  in the typical proportions 6-1-1 to 8-2-1 by volume and was chosen to remove heavy metals and to prevent displacement replating from solution by forming soluble complexes with the resulting ions. The reagents used in these two solutions were chosen over other possible combinations because they are completely volatile. The cleaning action of the dilute  $\text{HCl-H}_2\text{O}_2$  solution is similar to that of concentrated  $\text{H}_2\text{SO}_4\text{-H}_2\text{O}_2$ , or that of chromic-sulfuric acid mixtures, but is not as hazardous and presents no disposal problems.