

USE OF REVERSE OSMOSIS FOR ULTRAPURIFICATION OF HYDROGEN PEROXIDE TO SEMICONDUCTOR GRADE

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Abstract

Semiconductor industry requires the highest standard of purity for hydrogen peroxide, because its use for cleaning wafer surfaces of foreign contaminants or removing photoresists implies direct contact between silicon and chemical. Typically, the sub-ppb range for metals and sub-ppm for anions are needed, as indicated by widely accepted standards for electronic chemicals such as SEMI C30-1101 for H₂O₂ 30-32% (where six purity grades are defined: Grades 1-5 and VLSI Grade, corresponding to metal impurities limited from 1 ppm to 10 ppt).

The purity requirements for wet chemicals are becoming stricter as semiconductor technology advances, that implies to focus efforts on different fields: firstly, the manufacturing process of these chemicals for electronic applications, with the introduction of advanced purification technologies; on another front, the analytical determination of impurities, by means of high sensitivity techniques such as inductively coupled plasma mass spectrometry (ICP-MS) for metal traces and advanced ion chromatography (IC) for anion determination.

The state-of-the-art ultrapurification technologies for hydrogen peroxide tend to the integration of membrane separation and/or resin adsorption process for purifying industrial grade distilled hydrogen peroxide; being reported in the literature, in terms of patents, the application of reverse osmosis, ultrafiltration and ion exchange units. Previous studies of the research group report the use of ion exchange and membranes for the purification of another key chemical of semiconductor industry: aqueous hydrofluoric acid.

Taking into account that there is a lack of published papers concerning to the membrane process fundamentals for the purification of hydrogen peroxide, the present work is focused to this objective with the study of membrane technology in order to achieve electronic specifications, in this study SEMI Grade 3 (metals impurities limited to 10-1 ppb), and to advance the process fundamentals.

The experimental facility is a flat-sheet membrane unit for reverse osmosis at laboratory scale (SEPA CF II, GE Osmonics), made of materials compatible with concentrated hydrogen peroxide. The viability study is carried out for pressure levels from 5 to 40 bar with different commercial membranes: CE and AD (Osmonics), BE and CRM (Woongjin Chemical), SW30HR (Filmtec) and UTC 80 B (Toray). The total flux and ionic metal impurities rejections are evaluated, paying attention to the assessment of the permeation parameters of the membranes.

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