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New RASIRC Peroxidizer™ Delivers High Concentration Hydrogen Peroxide Gas into Semiconductor Processes

10x improvement over previous generation design

San Diego, Calif – June 17, 2015 – Today, RASIRC publicly announced the Peroxidizer™, a high concentration hydrogen peroxide (H_2O_2) vaporizer designed specifically for the needs of next generation semiconductor processes, These include Atomic Layer Deposition (ALD), annealing, cleaning and etching. The Peroxidizer is the first commercial vaporizer capable of delivering concentrations greater than 5% H_2O_2 gas by volume from 30% H_2O_2 liquid source. Delivered droplet-free and at temperatures as low as 80°C, H_2O_2 is a superior oxidant for use with new semiconductor materials and processes that are sensitive to high temperature and defects. The Peroxidizer delivers 10 times higher concentration than the previous technology it replaces.

The Peroxidizer eliminates problems associated with other oxidants used in semiconductor fabrication processes. Ozone and oxygen plasma are too aggressive, penetrating below the interface layer and damaging both surface structures and the bottom electrode. Both ozone and water have greater steric hindrance than H_2O_2, resulting in a less dense interface layer. In addition, plasma cannot deeply penetrate high aspect structures, resulting in non-uniform coatings. Water is less reactive than H_2O_2 gas. Water requires higher process temperatures, which makes it a poor choice with new materials, new precursors, and lower thermal budgets.

"The Internet of Things requires low power and high performance semiconductor devices, which will only be enabled through new materials and 3D architectures," explains Jeffrey Spiegelman, RASIRC Founder and President. "However, these new devices can only be processed at lower temperatures and their complicated physical structures make deposition and cleaning a new challenge for the semiconductor industry. The Peroxidizer is the first tool to enable stable and particle-free delivery of high

concentration hydrogen peroxide gas, enabling lower process temperatures, greater use of new materials and high process throughput. It is really exciting to bring an old molecule to market in a completely new state."

The Peroxidizer is the latest innovation in high purity gas generating products from RASIRC. Its Stabilized Gas Delivery system was the first in the industry to deliver high purity, stable H_2O_2 gas by overcoming Raoult's Law, which causes preferential selection of water molecules from H_2O_2 solution. The SGD used pre-humidification to ensure that the liquid H_2O_2 source remained at constant concentration while delivering H_2O_2 gas to process at a 50:1 water to H_2O_2 molar ratio. The Peroxidizer further reduces that ratio to 4:1, allowing as much as 5% H_2O_2 gas by volume to flow to process. The Peroxidizer eliminates the pre-humidification step by concentrating the liquid source until the molar ratio in the headspace reaches 4:1.

Atomic Layer Deposition (ALD)

H_2O_2 gas is more reactive than water at low temperatures. The Peroxidizer delivers H_2O_2 gas at temperatures as low as 80C, well below the H_2O_2 liquid boiling point. Low delivery temperatures enlarge the available thermal budget.

H_2O_2 gas achieves higher density nucleation than other oxidants. H_2O_2 has less steric hindrance than water or ozone because it decomposes into hydroxyls on surfaces. The resulting dense layer of hydroxyls creates an ideal surface for ALD.

High reactivity enables process engineers to use precursors that normally would not react with water or ozone. This reactivity also results in active removal of carbon.

The Peroxidizer delivers at a 4:1 water:H_2O_2 molar ratio, the most concentrated H_2O_2 gas delivery available and a 10x improvement over the previous generation from a 30% liquid source. Previous ALD studies frequently assumed that H_2O_2 was delivered at 4:1 ratio when in fact H_2O_2 delivery was much lower at 100:1. For the first time, ALD processes can use H_2O_2 with minimal interference from water vapor.

“High concentration H_2O_2 gas enables lower temperature processing, new precursor choices, better removal of residual carbon from the surface, and better initiation on the surface of the wafer,” stated Spiegelman. “All these advantages make hydrogen peroxide gas a very exciting new molecule for the ALD community.”

Annealing

High concentration H_2O_2 gas is well-suited for annealing applications where high speed deposition and low operating temperatures are required. H_2O_2 gas is a good oxidant that can penetrate deep structures. More aggressive oxidants like plasma and ozone can damage surface materials and sensitive structures. H_2O_2 gas reduces the required thermal budget, protecting against high heat exposure that causes film shrinkage.

“The ability to replace water vapor and steam with hydrogen peroxide gas reduces time and operating temperature. This will enable next generation gap fill technology, a critical milestone for success with 3D structures,” said Spiegelman.

Surface Preparation and Cleaning

Hydrogen peroxide gas enables dry in situ cleaning and surface preparation, eliminating the need for liquid baths and the contamination risk associated with transfers from bath to chamber. Less chemical is required for this dry process and no drying step is needed.

Hydrogen peroxide gas removes carbon-based contaminants on wafer surfaces while avoiding damage to device structures that can be caused by ozone or liquids. Organic hydrocarbons are oxidized, enabling their removal.

“The Peroxidizer gives fabs a great alternative to their current cleaning technologies,” said Spiegelman. “The ability to deliver hydrogen peroxide as a gas instead of a liquid speeds the move away from wet processing to more effective dry cleaning, which will be needed to support Moore’s Law.”

Versatility

With the Peroxidizer, process engineers can precisely control their processes. The

Peroxidizer delivers hydrogen peroxide gas in concentrations from 12,500 to greater than 50,000 parts per million depending on flow rate. This correlates to 1.25 to 5+% gas by volume delivery to process. The Peroxidizer supports carrier gas flows from 5 to 20 SLM in vacuum to atmospheric pressure. The Peroxidizer is available immediately. For details and to order, contact RASIRC.

About RASIRC

RASIRC specializes in products that generate and deliver gas to fabrication processes. Each unit is a dynamic gas plant in a box—converting common liquid chemistries into safe and reliable gas flow for most processes. First to generate ultra-high purity (UHP) steam from de-ionized water, RASIRC technology can now also deliver hydrogen peroxide gas in controlled, repeatable concentrations. RASIRC gas delivery systems, humidifiers, closed loop humidification systems, ands steam generators are critical for many applications in semiconductor, photovoltaic, pharmaceutical, medical, biological, fuel cell, and power industries. Call 858-259-1220, email info@rasirc.com or visit www.rasirc.com.

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