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Microelectronics

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Application Bulletin

Gas Purification for Thin Film Deposition

CIGS Photovoltaic Cells

The thin film active layers in copper indium gallium diselenide (CIGS) solar cells are frequently formed using sputter deposition. During this vacuum-based process, a plasma of electrons and ions are created from the inert argon gas. These ions dislodge atoms from the surface of a crystalline material which is then deposited to form an extremely thin coating on a substrate. Multicomponent films can be deposited with excellent stoichiometric accuracy.

Pall argon purification products remove moisture, oxygen, carbon monoxide, carbon dioxide and hydrocarbons thereby:

- improving film quality and
- reducing outgassing, leading to faster pump-down times

The Challenge

Typical argon impurity levels found in physical vapor deposition (PVD) / sputtering tools are: moisture (0.5 ppm), oxygen (2 ppm), and total hydrocarbons (0.4 ppm). Furthermore, the following contaminants, emanating from the process gases and gas delivery system components, are often present in the vacuum chambers: H_2O, O_2, CO, CO_2, H_2, N_2, methane and non-methane hydrocarbons. These contaminants are often adsorbed to the chamber walls under atmospheric conditions, but tend to desorb at the operating pressures typically used during sputter deposition (< 200 mT). Furthermore, the elevated temperatures required for thermal processing can exacerbate the release of gases from chamber walls.

Potential Problems

These trace contaminating gases can cause defects in the thin film layers in addition to increasing chamber pump-down times. Both vacuum and cryo pumps may be affected.

Oxygen contamination can lead to uncontrolled oxidation of metal layers and metal targets within the sputter or PVD tools. Trace water vapor can contribute both hydrogen and oxygen molecules to process chambers and metal layers. Carbon contamination might result in the formation of thin polymer films on process chambers and metal surface layers. Virtually all gaseous contaminants found in gas delivery systems and process gases can lead to upsets and longer process times, ultimately resulting in manufacturing yield losses and lower tool throughput. These factors can negatively impact overall tool cost-of-ownership (COO).

The control and reduction of trace oxygen and hydrocarbon species can be achieved using Pall purifiers with AresKleen™ INP medium.

The Solution

The recommended Pall argon purification and filtration products are:

- Gaskleen® II purifier assembly
  P/N GLP2INPVMM4 (for ≤3 slpm)
- Gaskleen ST purifier assembly
  P/N GLP5INPVMM4 (for ≤5 slpm)

The Gaskleen gas purifier assemblies combine AresKleen media with Ultramet-L™

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stainless steel filter media. APIMS test data show AresKleen INP medium has a strong affinity for oxygen and carbon containing molecular species in argon, effectively removing these impurities to sub-100 ppt levels.

Test Results

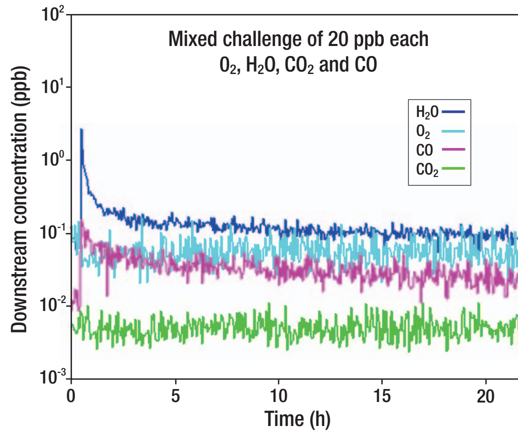

Figure 1. Removal of oxygen-containing compounds by Gaskleen II purifier

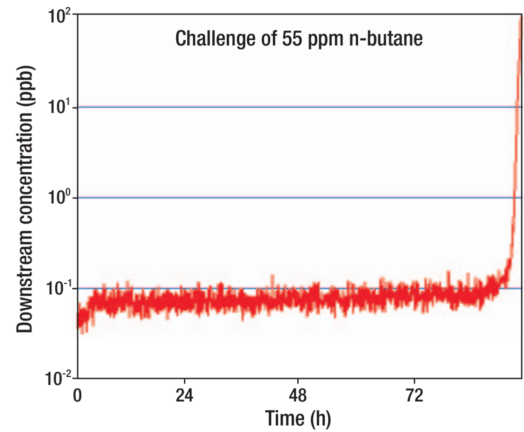

Figure 2. Removal of carbon-containing compound by Gaskleen II purifier

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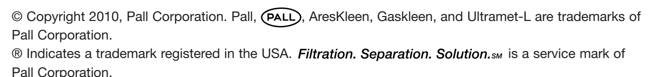

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