PACKAGING HIGH PURITY CHEMICALS TO ENSURE LOW PARTICULATE CONTAMINATION AT POINT-OF-USE

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Particulate control in high purity electronic chemicals requires that, in every step from chemical manufacture to use, a concerted effort be made to minimize contamination. In the packaging step, particulate contamination can arise from process piping and exposure to the atmosphere. Our data show that the first containers filled in each new lot of chemical contain contaminants from the process piping. Recirculation through filters can be used to reduce these particles. A clean room environment reduces introduction of airborne particulates into the products, but requires rigorous adherence to proper procedures.

The container used to transport a chemical from vendor to user can contribute greatly to particle count. Proper cleaning of the containers is necessary to remove particles before filling. In addition, containers are seldom truly inert with respect to their contents, and chemicals routinely extract from them particulates and cationic impurities. Particle shedding from containers cannot be stopped but can be controlled through container material selection. After all steps have been taken to minimize particle contamination, chemical purity and particulate contamination are verified by the quality control testing.

INTRODUCTION

As the chip geometries decrease, the tolerance for both size of particles and number of particles decreases. Particulate and chemical...
contamination must be controlled at every stage from product manufacture, packaging, distribution to the wafer fabrication facility, to delivery to point of use. Normal product specifications for chemicals, piping, valves, and packaging materials are not adequate to meet the requirements of the semiconductor industry. The semiconductor industry demands higher purity chemicals delivered at point-of-use than any other commercial application. Rigorous testing, not only of incoming raw materials and of process equipment coming in contact with the chemicals, is required to minimize particulate and metallic contamination. Packaging of semiconductor chemicals presents a unique set of problems requiring diligence to keep contamination from the product. This paper presents various aspects of the packaging process and how contamination in these areas can best be minimized.

STEPS TO OBTAIN LOW-PARTICULATE CHEMICALS

The Necessity of Thoroughly Cleaning Chemical Containers

One gallon containers, either polyethylene or glass, are not manufactured in clean room environments and, when received at the packaging plant, contain particles from many sources. Plastic containers pick up particles from ambient air used in blow molding and in subsequent handling, such as for trimming or leak testing. The containers are shipped to packaging plants in cardboard overpacks and some cardboard dust inevitably finds its way into the containers, providing another source of contamination, both chemical and particulate. To determine the potential for chemical contamination, a sample of typical cardboard packaging was analyzed for metal content. The results, shown in Table I, indicate that sodium, calcium, and aluminum are the greatest threat of contamination in high purity chemicals. With pressure from the semiconductor industry to continually lower impurity levels, it is imperative that all traces of cardboard be removed from containers.

The following procedures have been adopted to minimize not only cardboard contamination but also any other airborne particulate contamination from packaging containers. The bottles are inverted and blown with filtered air to remove gross contamination (Figure 1). This is followed by cleaning with filtered high purity deionized water. The water is pressurized to reach all interior areas of the bottle with sufficient force to wash out any remaining particles. The bottles are then dried by blowing filtered air into the containers. The cleaning environment is controlled to ensure that the clean bottles are not contaminated before filling and capping.