Airborne Molecular Contamination – Semiconductor Cleanrooms

When cleanroom air contamination is considered, the first thoughts are usually in terms of 'particulates.' These are microscopic particles of various sizes that can settle on a chip or wafer and possibly cause a short between the copper or semiconductor paths on the wafers. Standards, including Federal Standard 209E and ISO 14644-1, classify cleanrooms in terms of the number of particulates of different sizes that are found in the air.

These particles consist of millions or billions of molecules. But air contamination can also consist of single molecules of chemicals – in other words, gases. Depending on their chemistry, these gases can potentially corrode copper, attack the semiconductor, or change the electrical properties of the semiconductor. This 'airborne molecular contamination' is also addressed by standards. One such standard is the SEMI F21-1102 standard. SEMI is a global industry association of semiconductor manufacturers and suppliers. SEMI F21-1102 categorizes gases into four categories – acids, bases, condensables, and dopants - and classifies air contamination in terms of parts per trillion concentration of each category in the cleanroom air (see http://www.aafeurope.com/en/157/semi-f21-95).

In order to address possible VPI static control tile contributions to cleanroom air contamination, VPI looked at the VOCs (Volatile Organic Compounds) found in a test (California Department of Public Health/EHLB/Standard Method Version 1.1) designed to model indoor air quality in a classroom/office scenario. This test found a very small number of VOCs, consisting of low toxicity chemicals in the parts per trillion range in a classroom/office air modeling scenario. These are common chemicals found in many household products including over-the-counter medicines, foods and plastics.

These results were translated to the SEMI F21-1102 standard. In terms of the SEMI standard, these VOCs fall only into the Acids and Condensables categories. Importantly, none of these chemicals are considered dopants which, as mentioned above, can degrade semiconductor electrical properties.

Most critically, all VOCs found in VPI tile are at the parts per trillion level and fall below the maximums set forth in the SEMI standard. Specifically the California VOC results suggest the following SEMI F21-1102 classifications: MA-1,000, MB-1, MC-10,000 and MD-1. (Note: The California test modeling scenario uses an average classroom/office ceiling height of 8.5 ft. Any cleanroom with a greater ceiling height would see significantly lower classifications than indicated here).

These outstanding results, combined with VPI Conductile and Statmate ESD tile's other excellent performance properties, indicate why VPI is the best choice for semiconductor cleanroom static control flooring.