Environmental Health and Safety (EHS) Investigation on CVD Exhaust System: Identification and Mitigation of Potential Release of Process Gases and Byproducts

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Motorola has undergone the initiative to reduce perfluorocompound (PFC) emissions by converting from the standard in-situ cleaning chemistries on chemical vapor deposition (CVD) processes to NF3-based cleans using an available remote clean technology. With the process changes and increased fluorine generation, the severity of a post-plasma release is potentially greater than with the in-situ clean. In addition, concern has been raised of a potential post-plasma release of process gases and process byproducts from the exhaust system of a films CVD tool. Equipment Engineering investigated the concern and determined the cause of the potential release to be insufficient oxidation of all of the silane from the process in the controlled decomposition/oxidation (CDO). As a result of this determination, a second CDO was added to the system, the blast gate was removed, and the o-rings/fittings were replaced.

EHS conducted a comprehensive evaluation on a typical CVD exhaust system to identify and mitigate the risk of a potential release. This paper focuses on the evaluation methodology, findings and recommendations to minimize the risk of a potential release on a typical CVD exhaust system. ESIH conducted a safety evaluation using a failure modes effects analysis (FMEA) risk assessment. The FMEA methodology systematically identified the causes that could lead to a potential release of process gases or process byproducts. All of the causes have a common factor; an exhaust system failure that results in positive static pressure of the exhaust system. Potential causes of an exhaust system failure include an exhaust fan failure, a deposition of process byproducts sufficient enough to cause an exhaust obstruction, maintenance activities in which the damper or blast gate is adjusted, or removal of a section of the exhaust or foreline while the tool is running. In most cases, for a release to occur, controls to detect a pressure fault and to prevent the release would have to be either non-functional or bypassed. There are four significant recommendations that are essential to reducing the risk and preventing the release. These recommendations are as follow: (1) ensure alarms and interlocks to detect exhaust failure are not bypassed and are tied into the process equipment, (2) ensure equipment is in an offline mode, all hazards are isolated (lock out / tag out (LOTO)) and process gases (HPMs) are not flowing when performing preventive maintenance (PM) or adjustments to the exhaust system. Ensure LOTO procedures are clearly written in the work instruction for foreline removal, (3) increase the inspection frequency and include parametric monitoring using Magnahelics to ensure the exhaust system is maintaining adequate negative pressure, and (4) notify Facilities prior to making any adjustments to the exhaust system. All of these recommendations to mitigate the risk of a potential release should be incorporated into the appropriate procedural documentation to ensure system integration.

References: [1] Nauert, C., Brown, P.T., Flood, J., Mendicino, L., A. Atherton, Silvetti, D., Nowak, T., A. Johnson, Hartz, C., P. Maroulis, "PFC Emissions Reduction for Lamp Heated CVD Chambers with Applied Materials Remote Clean Technology", Semicon SW, October, 2000. [2] Vartanian, V. Goolsby, B., Mendicino, L., Brown, P.T., Raley, B., Filipiak, S., Laush, C., "Analysis of the Fate of F2 Emissions from NF3-based CVD Chamber Cleans," Presentation at International SEMATECH PFC WG Meeting, October 17, 2000.