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Contact cleaning technology and plasma treatment -A comparison



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CAPABILITIES, ADVANTAGES AND LIMITATIONS OF CONTACT CLEANING AND PLASMA TREATMENT METHODS IN SMT AND PCBA

Among the prevalent methods, contact cleaning and plasma cleaning offer distinct advantages and limitations. This report provides a comprehensive comparison of these technologies based on their capabilities, advantages, and limitations, highlighting their suitability for various contamination challenges in SMT and PCBA sectors.

Improving yields and performance in advanced electronics production necessitates effective contamination removal techniques.

Contamination during the PCBA process, primarily from foreign object debris (FOD) and chemical oxidation, significantly impacts first-time yields. Effective contamination control is essential for achieving high-quality and reliable electronic assemblies.

Two prominent cleaning technologies – contact cleaning and plasma treatment – are evaluated to determine their efficacy in addressing challenging contamination issues.

Plasma treatment

CAPABILITIES

- **1 Surface Treatment:** Effective in removing organic contaminants and oxides, enhancing surface energy and wettability.
- **2 Oxide Removal:** Can eliminate oxide layers on PCB pads, beneficial for subsequent soldering processes.
- **3 Versatility:** Applicable for surface activation and improving adhesion properties through surface roughening.

Contact cleaning

CAPABILITIES

- **1 Particle Removal:** Highly effective in removing a wide range of particle sizes (20 nm to larger particles like human hairs).
- 2 **Efficiency:** Capable of cleaning surfaces without introducing defects or causing micro-damage.
- **3 Static Control**: Meets ANSI/ESD S20.20 standards, ensuring low static generation during the cleaning process.

ADVANTAGES

- **1 Effective Organic Removal:** Excels at breaking down and removing organic materials, providing a contaminant-free surface.
- 2 Environmental Safety: Utilises gases like oxygen and argon, which are environmentally safe and efficient in cleaning processes.
- **3 Surface Activation:** Enhances surface properties for better adhesion, beneficial for various manufacturing processes.

ADVANTAGES

- **1 Comprehensive Particle Removal:** Superior in eliminating all types of particles, ensuring a clean surface before solder paste application.
- 2 No Surface Damage: Does not increase substrate roughness or cause micro-melting, preserving the integrity of delicate components.
- **3 Low Energy Consumption:** Operates without high electricity demands, making it cost-effective.
- **4 High Process Speed:** Suitable for high-speed, in-line cleaning applications, supporting high-throughput manufacturing environments.
- **5 Minimal Surface Energy Impact:** Does not significantly alter surface energy, as indicated by stable contact angle measurements post-cleaning.

LIMITATIONS

- **1 Limited Particle Removal:** Ineffective at removing inorganic and metal particles, which constitute a significant portion of PCBA contaminants.
- 2 High Energy Consumption: Demands significant electrical energy for plasma generation, increasing operational costs.
- **3 Surface Roughening:** Can roughen surfaces, impacting high-frequency signal performance and potentially damaging sensitive substrates.
- **4 Safety Concerns:** Generates ozone and other byproducts, necessitating effective extraction systems to ensure safety and environmental compliance.

LIMITATIONS

- **1 Chemical Contaminant Removal:** Ineffective at removing chemical contaminants or oxides, limiting its use to particle removal tasks.
- **2 Dependence on Adhesive Roll:** Requires an engineered adhesive roll to maintain cleaning efficiency requiring regular refresh.

Contact cleaning is a low cost, highly effective contamination control solution.

COMPARATIVE ANALYSIS: At a glance

Building on the analysis presented overleaf, the table below provides a comparison of the cleaning effectiveness for both methods for different types of FOD including human hair, plastics, organic residues and metallic particles.

Tekkie fact:

Contact cleaning is highly effective at removing metallic particles.

Contaminant type	Plasma treatment effectiveness	Contact Cleaning effectiveness	Explanation
Human Hair	Low	High	Contact cleaning uses elastomer rollers to mechanically remove larger unattached particles like hair.
Skin Particles	Low	High	Elastomer rollers in contact cleaning are effective at picking up skin particles.
Glass Particles	Low	High	Contact cleaning can efficiently remove dry unattached particles like glass through mechanical action.
Plastic Particles	Low	High	Dry unattached plastic particles are effectively removed by the mechanical action of contact cleaning.
Organic Residues	High	Low	Plasma cleaning excels at removing organic residues by breaking them down chemically.
Thin Oxide Layers	Moderate to High	Low	Plasma can remove thin oxide layers from surfaces whereas contact cleaning is not designed for this purpose.
Surface Contaminants	High (if organic or thin films)	High (if particulate matter)	Plasma cleaning is effective for thin organic films while contact cleaning is effective for particulate contaminants.
Metallic Particles	Low	High	Contact cleaning is very effective in removing dry, unattached metallic particles through mechanical action.

CONCLUSION

Both contact cleaning and plasma treatment offer unique advantages tailored to specific contamination challenges in the PCBA process. Contact cleaning excels in particle removal, providing a defect-free surface without altering surface properties. Plasma treatment, while not effective for particle removal, is valuable for eliminating organic contaminants and oxides, enhancing surface activation.

In high-volume PCBA environments, a combined approach leveraging both technologies may offer the most comprehensive solution, addressing a broader spectrum of contamination issues.

The choice between contact cleaning and plasma cleaning should be guided by the primary contamination type and the specific requirements of the manufacturing process.

Tekkie fact:

Contact Cleaning is best for particle removal, plasma for removing organic contaminants. The methods can complement each other.



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