

## **CMP (Chemical-Mechanical-Polishing) System Technical Specification:**

This specification defines the technical requirements for a CMP system capable of performing chemical-mechanical polishing processes for MEMS, wafer thinning, and surface planarization applications, covering sample sizes from 10 mm x 10 mm up to 4-inch wafers.

### **1. General System Requirements**

- i. The system shall operate based on the Chemical Mechanical Planarization (CMP) principle.
- ii. Processable sample range shall include a minimum sample size of 10 mm x 10 mm and be compatible with 4" wafers.
- iii. The system shall be suitable for research and prototype manufacturing processes.
- iv. The system shall be equipped with an enclosed safety cabinet to protect against chemical splashes.
- v. The system shall be fully compatible with the Turkish electrical infrastructure (220-40 V AC single-phase or 380-400 V AC three-phase, 50 Hz).

### **2. Polishing Platen**

- i. The platen should be suitable for processing sample sizes from 10 mm x 10 mm to 4" wafers.
- ii. Platen speed shall be adjustable over a wide range and shall cover the commonly used CMP operational range of approximately 30-100 rpm.
- iii. The platen shall be capable of rotating in both CW (clockwise) and CCW (counterclockwise) directions.
- iv. Pad replacement shall be quick and easily performed by the operator.

### **3. Polishing Head / Carrier System**

- i. Appropriate carriers shall be provided for both 10 mm x 10 mm samples and 4" wafers.
- ii. The system shall allow the use of adapters or fixtures for small samples.
- iii. The carrier's vertical motion (up/down) shall be driven by a motorized or controlled mechanism.
- iv. Polishing head speed shall be adjustable and shall cover the typical CMP operational range of approximately 20-100 rpm.
- v. Downforce/pressure shall be adjustable over a range suitable for both low-pressure polymer CMP and higher-pressure metal/dielectric CMP.
- vi. The system shall include an automatic lateral sweeping/oscillation mechanism to improve surface uniformity.

### **4. Conditioning Features**

- i. The system shall support both in-situ and ex-situ pad conditioning.
- ii. During conditioning, speed and time parameters shall be adjustable.
- iii. Depending on the system design, conditioning motion (oscillation/sweep) shall also be controllable.

## 5. Slurry Delivery System

- i. The system shall include an integrated slurry supply infrastructure.
- ii. Slurry delivery shall support one or multiple chemicals with adjustable flow rate.
- iii. DI water rinse capability shall be provided.

## 6. Software and Recipe Management

- i. The system shall operate through a PC-based interface or an integrated control panel.
- ii. It shall allow the creation of multi-step CMP recipes with at least 10 programmable steps.
- iii. Each step shall include adjustable parameters (duration, platen speed, head speed, pressure, slurry flow rate, conditioning parameters).
- iv. Process parameter logging/data recording shall be supported.

## 7. Surface Roughness Performance

The system shall provide the control precision necessary to achieve the following surface roughness levels, which may vary depending on pad, slurry, and chemical process conditions:

- i. Copper (Cu) planarization: Target Ra  $\leq$  5 nm
- ii. Silicon & SiO<sub>2</sub> surfaces: Target Ra  $\leq$  2 nm
- iii. Polymer surfaces (SU-8, PI, BCB, etc.): Target Ra  $\leq$  20 nm

## 8. Safety

- i. The protection/safety system may be designed with or without a physical lid depending on the manufacturer's implementation; however, it shall prevent operator access to rotating parts.
- ii. An emergency stop button shall be provided.
- iii. Internal surfaces shall be resistant to chemical exposure.
- iv. Overload protection shall be included.

## 9. Delivery and Training

- i. The system shall be delivered with all required components.
- ii. On-site installation shall be provided.
- iii. Operational, process, and maintenance training shall be delivered.

## 10. Warranty and Service

- i. The system shall be supplied with a minimum warranty period of 1 year.
- ii. Technical support (spare parts and labor) shall be available for at least 10 years.
- iii. In case of malfunction, remote support shall be provided within 2 days, and on-site support shall be offered within a reasonable intervention period committed by the manufacturer.