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Title: Substrate Preparation & Sequential Solvent Cleaning SOP	Author: Kadeem Manning (Tier II Tech)	Status: Approved

Substrate Preparation & Sequential Solvent Cleaning Protocols

Standardized Laboratory Procedure for Surface Contamination Removal, Ultrasonic Cleaning, and Handling

1. Purpose & Scope

This Standard Operating Procedure (SOP) defines the rigorous multi-bath ultrasonic solvent cleaning, deionized water rinsing, and drying protocols required for preparing substrates (silicon, glass, quartz, metallic wafers) prior to thin-film deposition or vacuum chamber loading. Contamination from organic residues, oils, or airborne particulates drastically increases outgassing loads and severely degrades thin-film adhesion and vacuum performance.

2. Environmental Health & Safety (EHS) & PPE Requirements

- Personal Protective Equipment (PPE):** Nitrile gloves (minimum 6 mil), splash-resistant safety goggles/glasses (ANSI Z87.1), and laboratory coat are mandatory.
- Chemical Fume Hood Operation:** All solvent handling (Acetone, Isopropanol) must occur strictly inside a certified chemical fume hood with face velocity ≥ 100 fpm. Never heat solvents in sealed containers.
- Waste Disposal:** Used solvents must be collected in labeled, dedicated hazardous waste carboys. Never pour solvents down laboratory drains.

CRITICAL MANDATORY GLOVE POLICY: Powder-free nitrile gloves **MUST** be worn at all times when handling cleaned substrates or internal vacuum chamber tooling. Skin contact transfers hydrocarbon oils, creating permanent outgassing sources and virtual leaks.

3. Equipment, Reagents & Consumables

Item / Reagent	Grade / Spec	Function / Purpose
Acetone	HPLC / Electronic Grade ($\geq 99.9\%$)	Primary organic degreasing and lipid dissolution
Isopropanol (IPA)	Electronic Grade ($\geq 99.9\%$)	Secondary solvent rinse & acetone residue removal
Deionized (DI) Water	Milli-Q / Resistivity >18.2 M Ω -cm	Final ionic and particulate rinse
Ultrasonic Bath	Multi-frequency (28/40 kHz) with heater	Acoustic cavitation particulate detachment
Dry Nitrogen (N2)	High-Purity ($\geq 99.999\%$), filtered 0.2 μ m	Surface blow-drying without water spotting
PTFE Substrate Caddies	Acid/solvent resistant fluoropolymer	Chemical-resistant substrate immersion holding

4. Sequential Step-by-Step Cleaning Procedure

Phase 1: Acetone Ultrasonic Degreasing Bath

- Load substrates into a clean PTFE immersion caddy.
- Fill a clean glass beaker with Electronic Grade Acetone to submerge all substrates.
- Place beaker in ultrasonic bath (water temperature 40°C) and operate at 40 kHz for 10 minutes.
- Carefully remove caddy; do NOT allow acetone to dry on substrate surfaces.

Phase 2: Isopropanol (IPA) Rinse & Ultrasonic Bath

- Immediately transfer substrates into a second beaker containing fresh Electronic Grade IPA.
- Ultrasonic clean at 40 kHz for 10 minutes at 40°C. IPA removes residual acetone and dissolved organics.

Phase 3: Deionized Water Overflow Cascade Rinse

- Transfer substrates into a beaker filled with Milli-Q DI Water (>18.2 M Ω -cm).
- Execute ultrasonic agitation for 5 minutes, followed by a 2-minute continuous DI water cascade overflow rinse.

Phase 4: High-Purity N2 Blow-Drying & Desiccator Storage

1. Individually hold each substrate with fluoropolymer-coated tweezers inside the fume hood.
2. Direct a stream of filtered dry N2 gas at a 45° angle, pushing liquid droplets off the surface from top to bottom.
3. Visually inspect under bright directional light for water spots or particulate streaks.
4. Place cleaned substrates into a vacuum desiccator or sealed N2 storage cabinet immediately.

5. Quality Assurance Verification & Authorization Sign-Off

Pass Criteria: Substrates must exhibit a continuous, unbroken liquid film during DI water rinse (Water Break Test) and zero visible residue/haze under 10x optical inspection. Cleaned substrates stored longer than 24 hours in desiccators must undergo a 3-minute N2 plasma clean prior to chamber loading.

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