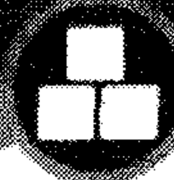
발표주제 3

차세대 Poly Etcher 장비에 요구되는 요소 기술의 이해

손종원 부사장, 주성엔지니어링



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차세대 Poly Etcher 장비에 요구되는 요소 기술의 이해

2008. 05. 16

손 종 원

JUSUNG ENGINEERING Co., Ltd.

Outline

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1. Tachyon 주성 Poly Etcher 소개
2. Process Result
3. 차세대 Poly Etcher 요소 기술
4. Summary

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Tachyon Plus 소개

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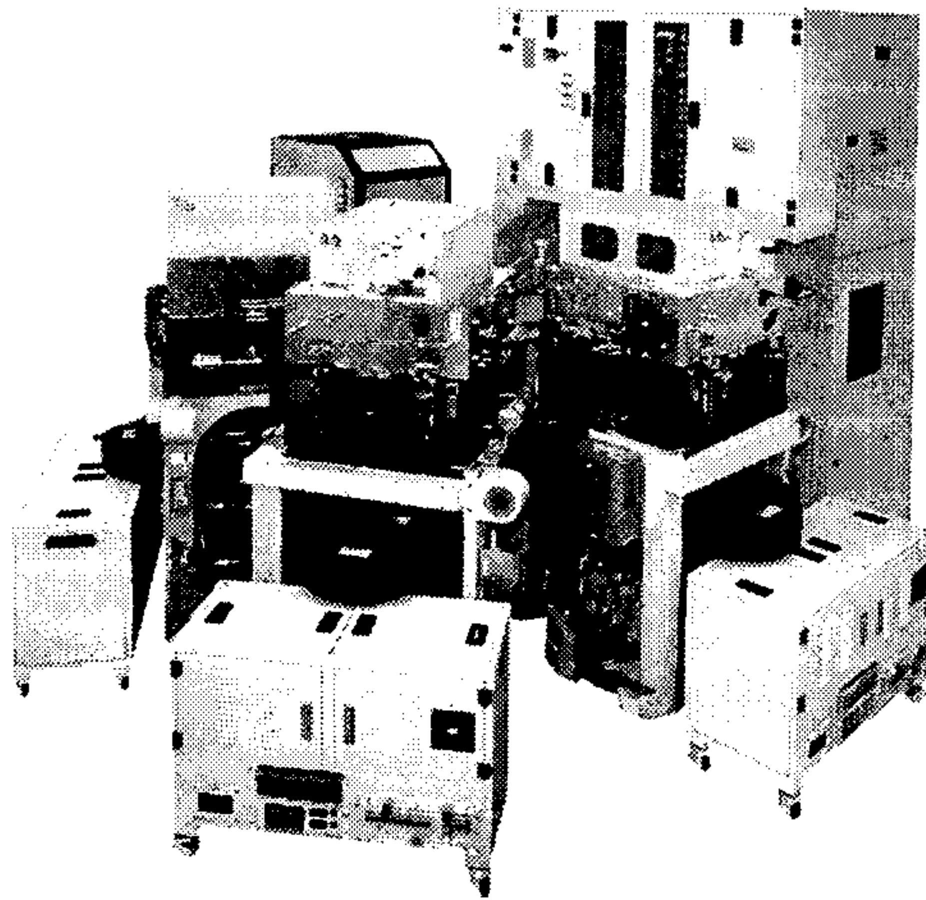

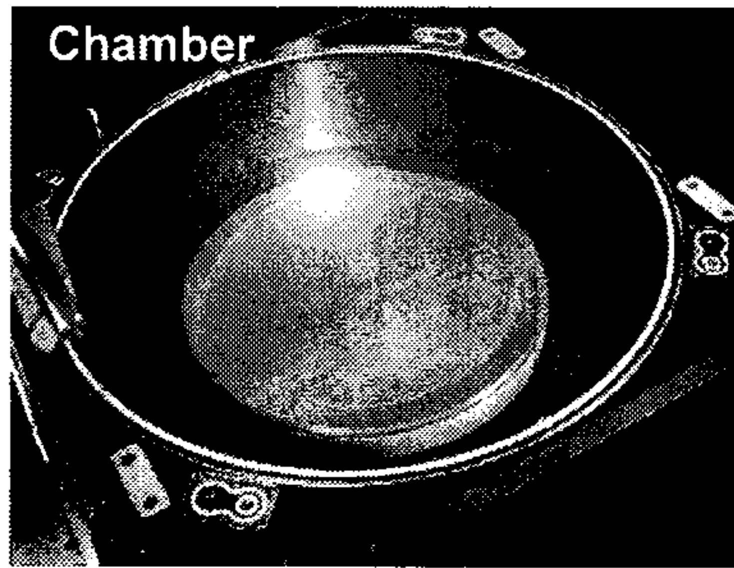

❑ **Plasma Source & High Performance H/W**

- Dual coil 병렬 공진 antenna source(주성 특허Source)
- Symmetric gas flow by center pumping
- Particle reduction design
- Jusung made TM
  - → Vent & pump time 감소@ LL & High speed robot

❑ **양산 신뢰성 확보 완료**

- 60nm 생산 적용 중
- 높은 가동률 > 95%
- 경쟁사 대비 > 30% High throughput
- Low CoO & CoC(경쟁사 대비 30% ↓)

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World Best VHF ICP Plasma Source

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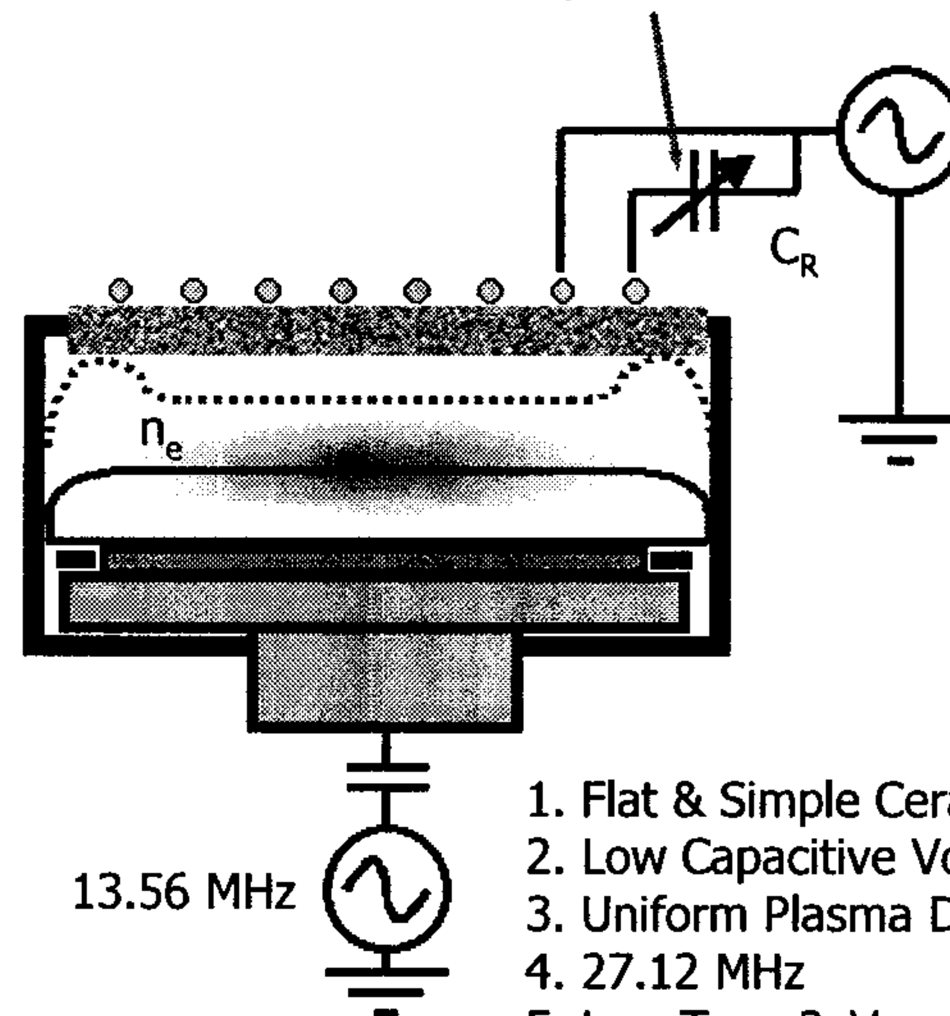
High Frequency & Parallel Resonance Antenna

1. **Low Antenna Inductance**
   - → **고주파에 대한 matching 안정성**
2. **Inner/Outer Current Control**
   - → **Good uniformity 제어**
3. **Low Capacitive Antenna Voltage**
   - → **Particle 최소화**
4. **Low Electron Temperature**
   - → **Plasma damage free**

❖ Outer current 안테나에 resonance capacitor를 control를 통해 uniform plasma density 형성



1. Flat & Simple Ceramic
2. Low Capacitive Voltage
3. Uniform Plasma Density
4. 27.12 MHz
5. Low Te < 2eV

주성 특허 Source

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Process Result for 60nm W Bitline Etch

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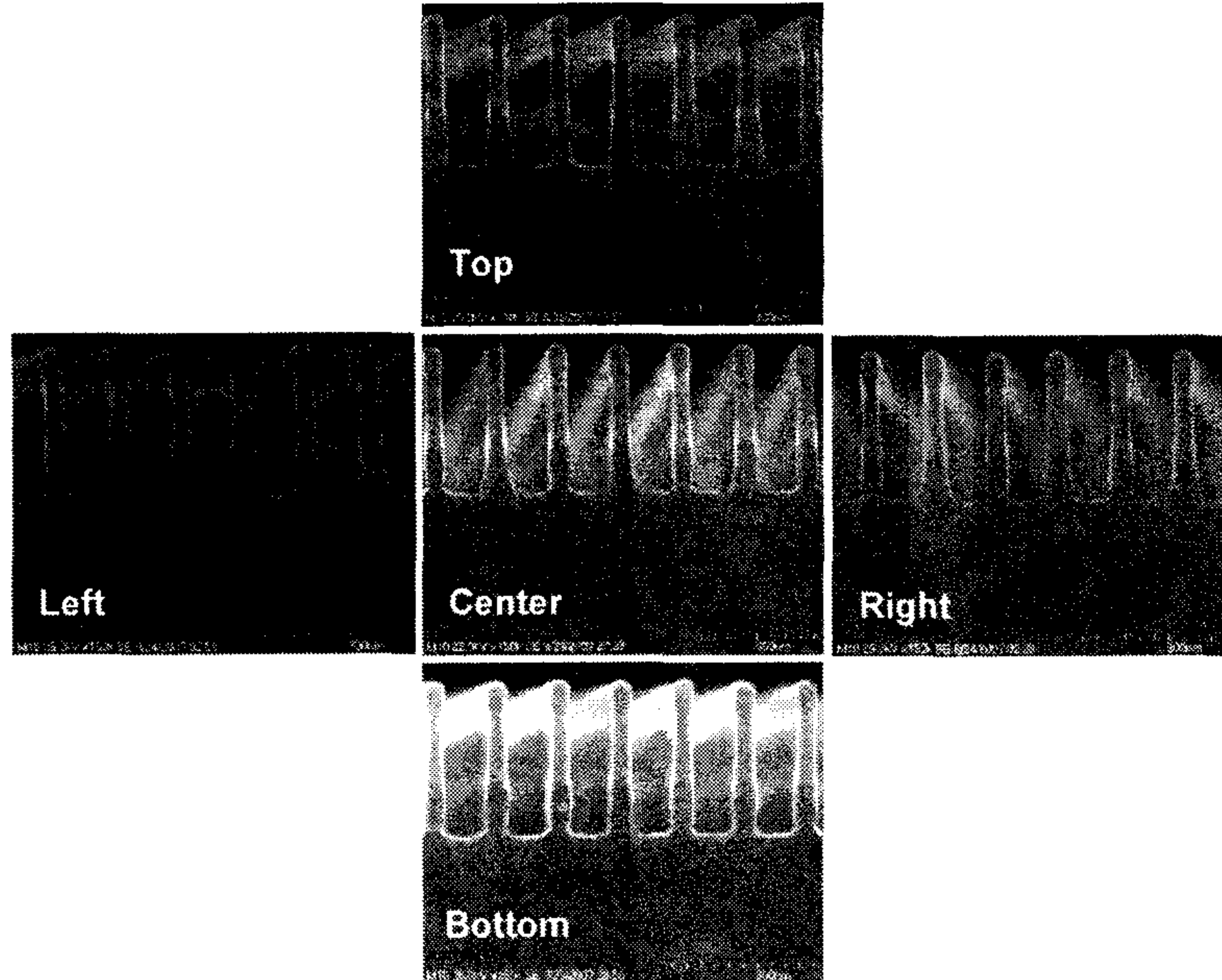
❑ Profile & CD Result for 60nm W Bitline Etch



					63.1	60.9	61.8					
		62.2	59.7	60.7	58.8	60.6	59.8	59.2	59.3	62.4		
	60.4	58.7	57.4	56.1	57.1	55.9	57.4	59.0	61.0	59.8	58.3	
61.2	59.4	58.7	59.9	58.2	57.3	57.9	58.6	57.0	59.0	57.8	60.5	60.5
60.8	58.4	58.1	58.0	58.9	60.0	57.9	58.9	56.6	59.7	60.5	59.5	60.1
57.5	57.6	60.3	59.3	59.0	57.6	59.3	58.5	57.4	57.4	57.4	58.3	60.3
60.6	59.1	57.8	57.2	57.8	59.5	59.1	58.9	58.4	59.0	60.0	59.9	60.7
61.0	60.0	57.5	57.3	58.2	59.2	57.3	58.6	57.8	59.7	60.2	60.6	62.4
	60.6	58.2	58.3	57.5	58.2	58.4	58.3	58.4	59.8	61.9	60.2	
		60.1	59.5	59.0	59.6	59.0	59.2	60.9	60.3	59.3		
				61.6	60.4	61.0	61.5	62.0				

AVG : 59.2nm (Spec-58 ± 5nm)
Max : 63.1nm
Min : 55.9nm
Range : 7.3nm
3σ : 4.4 (Spec - 3σ : < 7)

❑ **Vertical Profile**
❑ **Remained α- C : > 650 Å**

Excellent CD Uniformity !!!

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Process Result for 45nm ISO_STI Etch

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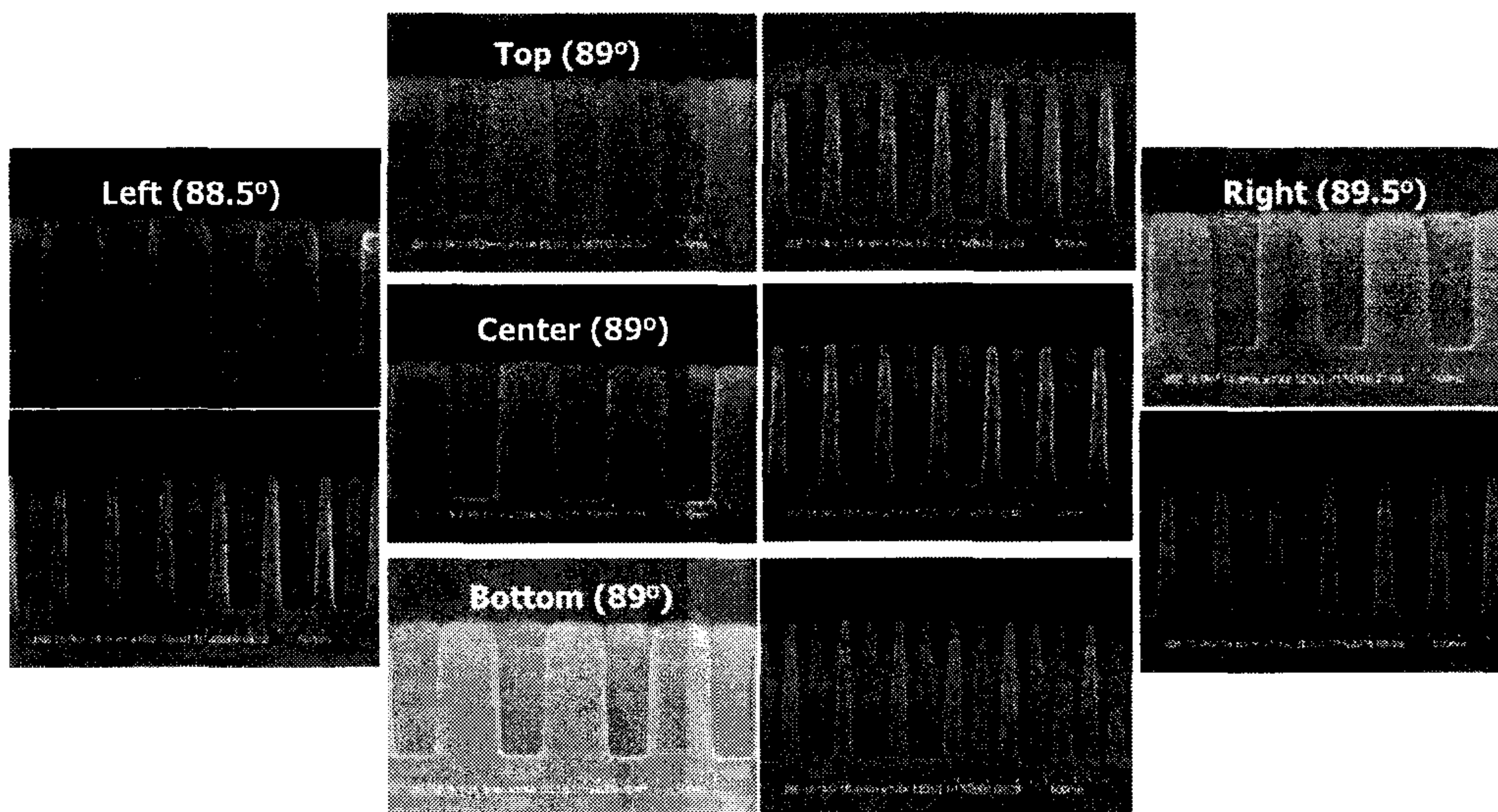
❑ STI Etch



❑ **Vertical Profile & Good CD Uniformity**

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차세대 Poly Etcher 필요한 요소 기술

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1. **Low Pressure High Conductance 공정**
2. **High Density Plasma**
3. **Surface Temp. Control**
4. **Dual gas injection**

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Low Pressure 공정

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1. **Issue :**
   - **<40 nm Microloading (Iso_Dense) & RIE Lag 에 의한 CD Variation**
   - **> 5mTorr에서는 Vertical Profile 구현 어려움**

2. **Needs :**
   - **Process Pressure < 1~3m torr**

3. 요구 기술
   - 대용량 **TMP**
   - **High Conductance Ch. Design**
   - **High Density Plasma (>~10^{11}/cm^3)Source @ < 1~3mTorr**

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High Density Plasma Source

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1. **Issue : @ < 40nm Tech. Node**
   - **Low Pressure**에 의한 **Etch Rate** 감소
   - **Selectivity** 저하
   - **> 5mTorr**에서는 **Vertical Profile & Good CD** 구현 어려움

2. **Needs :**
   - **High Density Plasma (>~$10^{11}/cm^3$)Source @ < 1~3mTorr**

3. 요구 기술
   - **New Concept Plasma Source** 기술
     - ➢ **Radical generation control by electron temperature**
     - ➢ **Etch profile & selectivity improve by ion energy control**
   - **Pulse Modulation Plasma** 기술
   - **Easy Scalability**
   - **Center/Edge**간 **Plasma Tuning** 기능

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Surface Temp. Control

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1. **Issue : @ < 40nm Tech. Node**
   - **Center/Edge**간 온도 차이에 의한 **CD Variation**
   - **Mutistep Material Etch**에 의한 **Profile Variation**

2. **Needs :**
   - **Center/Edge**간 독립적인 **Temp Control (Radial Temp Control)**
   - **Step to step Temp Ramp up/down speed >3℃/sec**
   - **Max. Temp > 150℃**

3. 요구 기술
   - **Heater Pattern Simulation Tech.**
   - **Temp** 제어 기술 **@ < 100℃**
   - **Thermal Dynamic Tech.**
   - **Ceramic** 물성 및 재료 기술
   - **Ceramic Plate** 제작 및 가공 기술

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Gas 분사 기술

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1. **Issue : @ < 40nm Tech. Node**
   - Center/Edge간 Gas flow에 따른 Radical 정도 차이에 의한 CD Variation

2. **Needs :**
   - Center/Edge간 독립적인 Gas Ratio Control

3. 요구 기술
   - **Gas 분포 Simulation 기술.**
   - **High Conductance Ch. Simulation 기술**
   - **Gas 분사 형태 Simulation 기술**

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Summary

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- ❑ **Field Proven High Productivity & Reliability for 중요 공정**
  Higher Throughput against competitor tool
- ❑ **Simple Design Concept**
- ❑ **Lower CoC & CoO**
- ❑ 차세대 요소 기술 개발 필요

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