

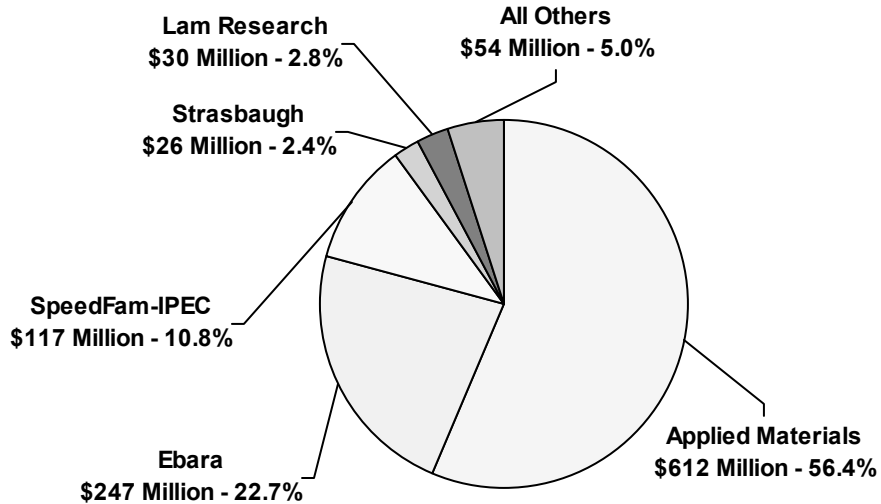
# **CMP Market And Technology Status - 2002**

**Tom Tucker  
Laredo Technologies  
247 East Many Lakes Drive  
Kalispell, Montana 59901  
(406) 755-3815**

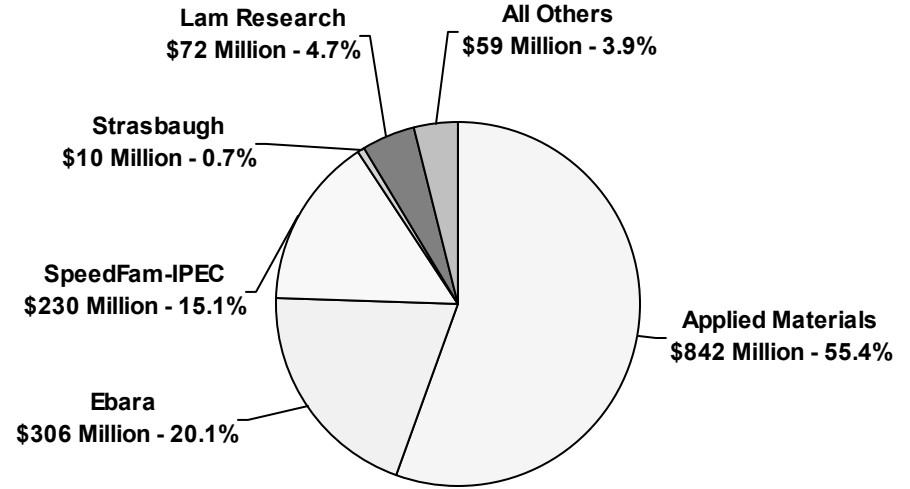
# Agenda

- ❖ **Review of 2001 CMP Markets**
- ❖ **Forecast For CMP Market Segments For 2002-2008**
- ❖ **Potential Technology Shifts That Can Impact CMP Markets (And This Forecast)**
  - **Review of 2001 US CMP Related Patent Activity**
  - **Possible Technologies For Planarizing Mechanically Weak Interconnect Structures**
- ❖ **Conclusions**

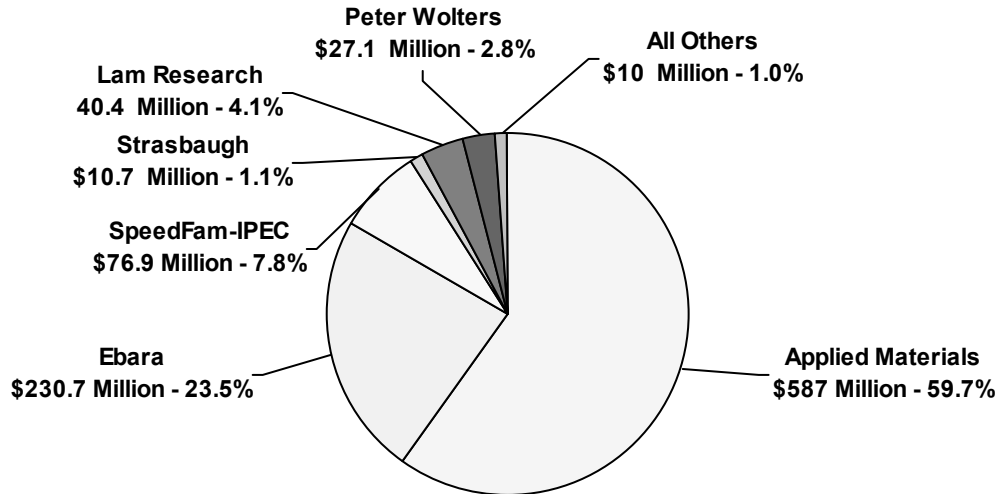
# CMP Revenue Market Shares: 1999 - 2001



1999 Revenues - \$1.086 Billion

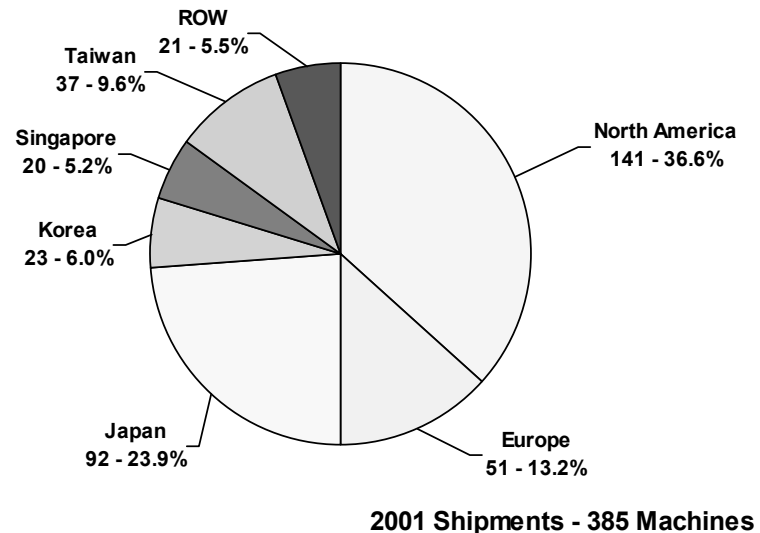
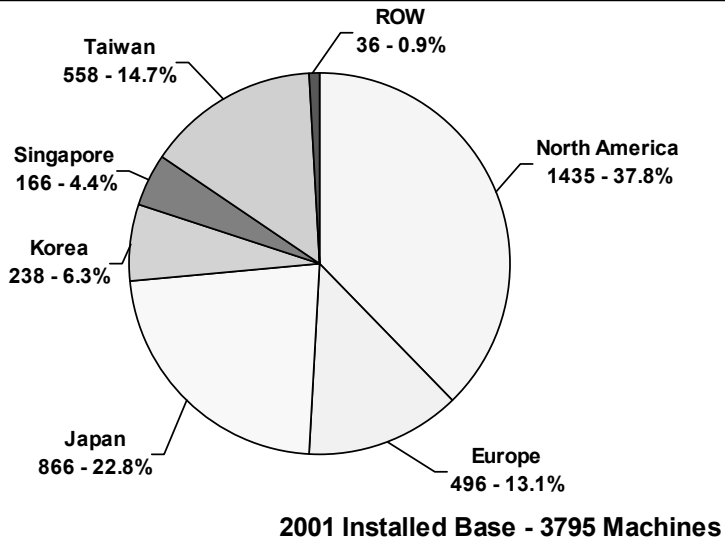
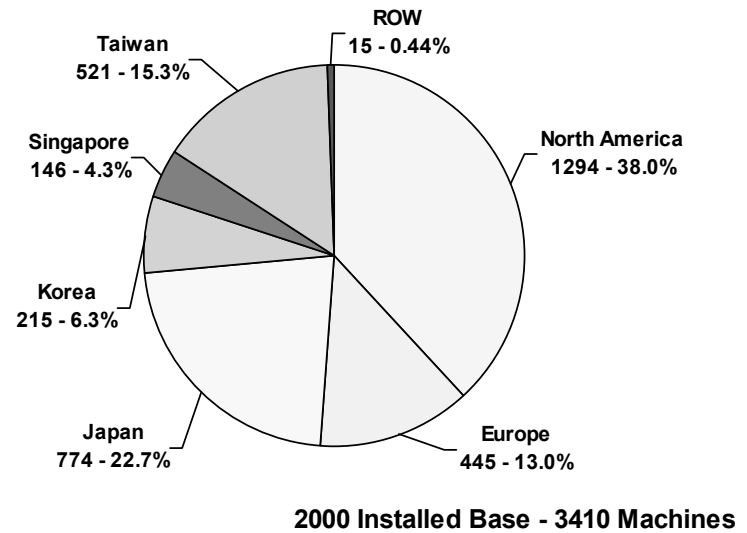
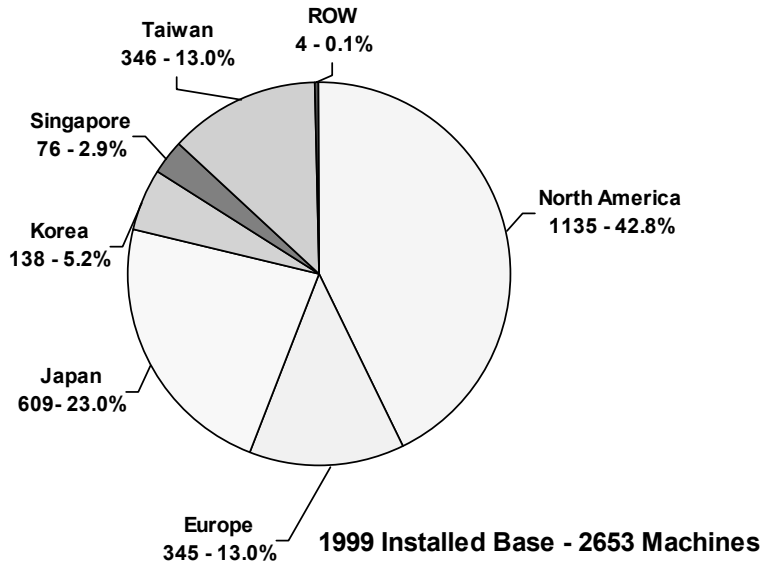


2000 Revenues - \$1.519 Billion

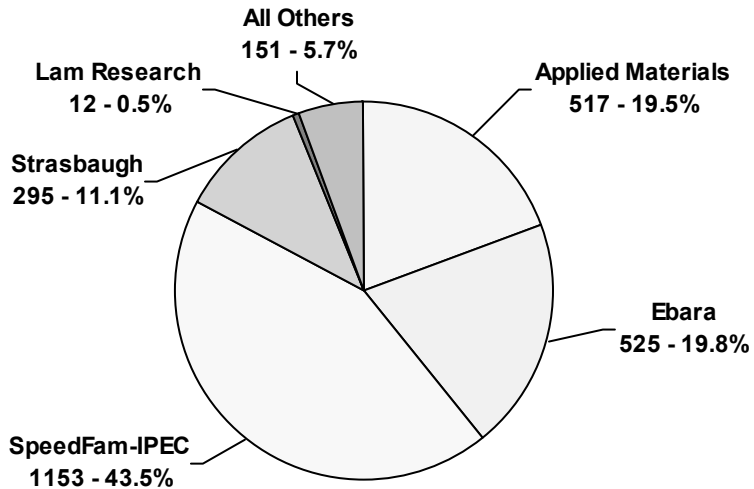


2001 Revenues - \$982.8 Million

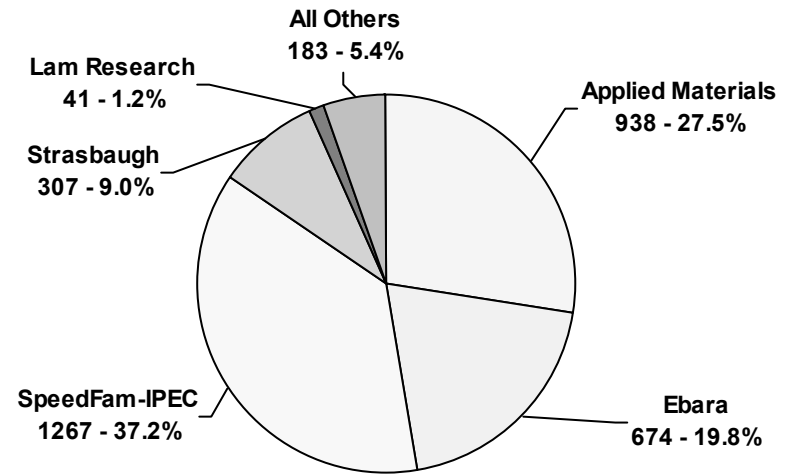
# Geographic Distribution Of CMP Tool Shipments For Calendar Year 2001



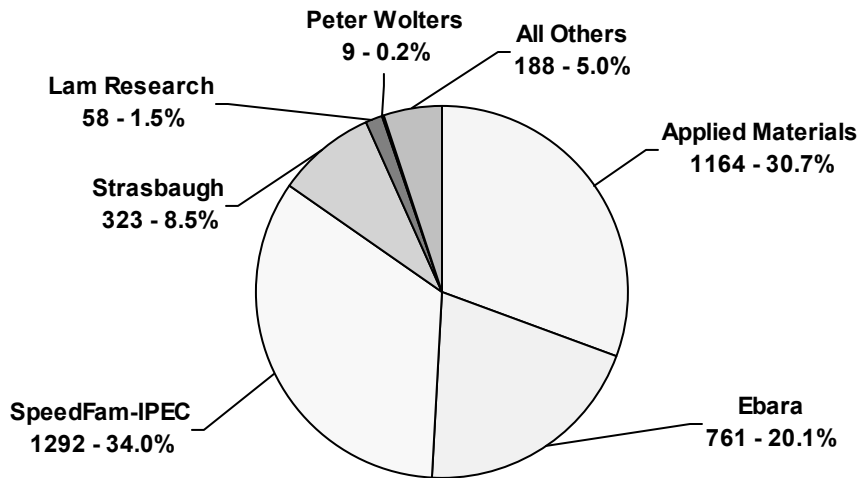
# CMP Tool Shipments For Calendar Year 2001 By Supplier



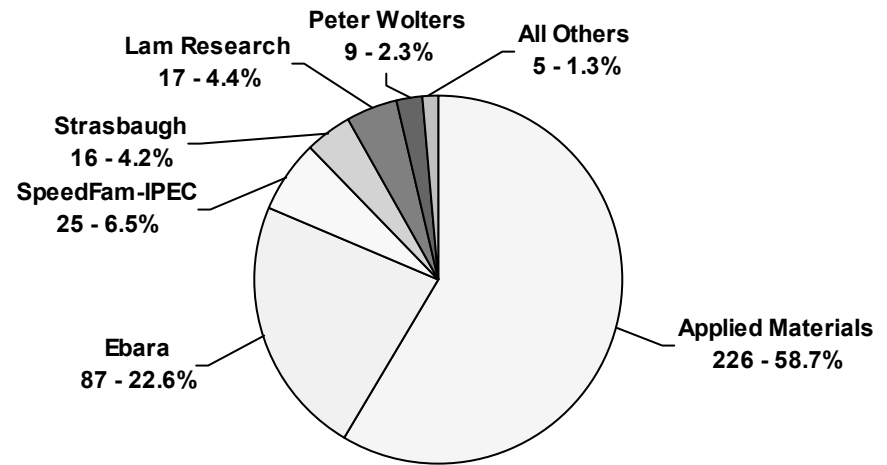
1999 Installed Base - 2653 Machines



2000 Installed Base - 3410 Machines

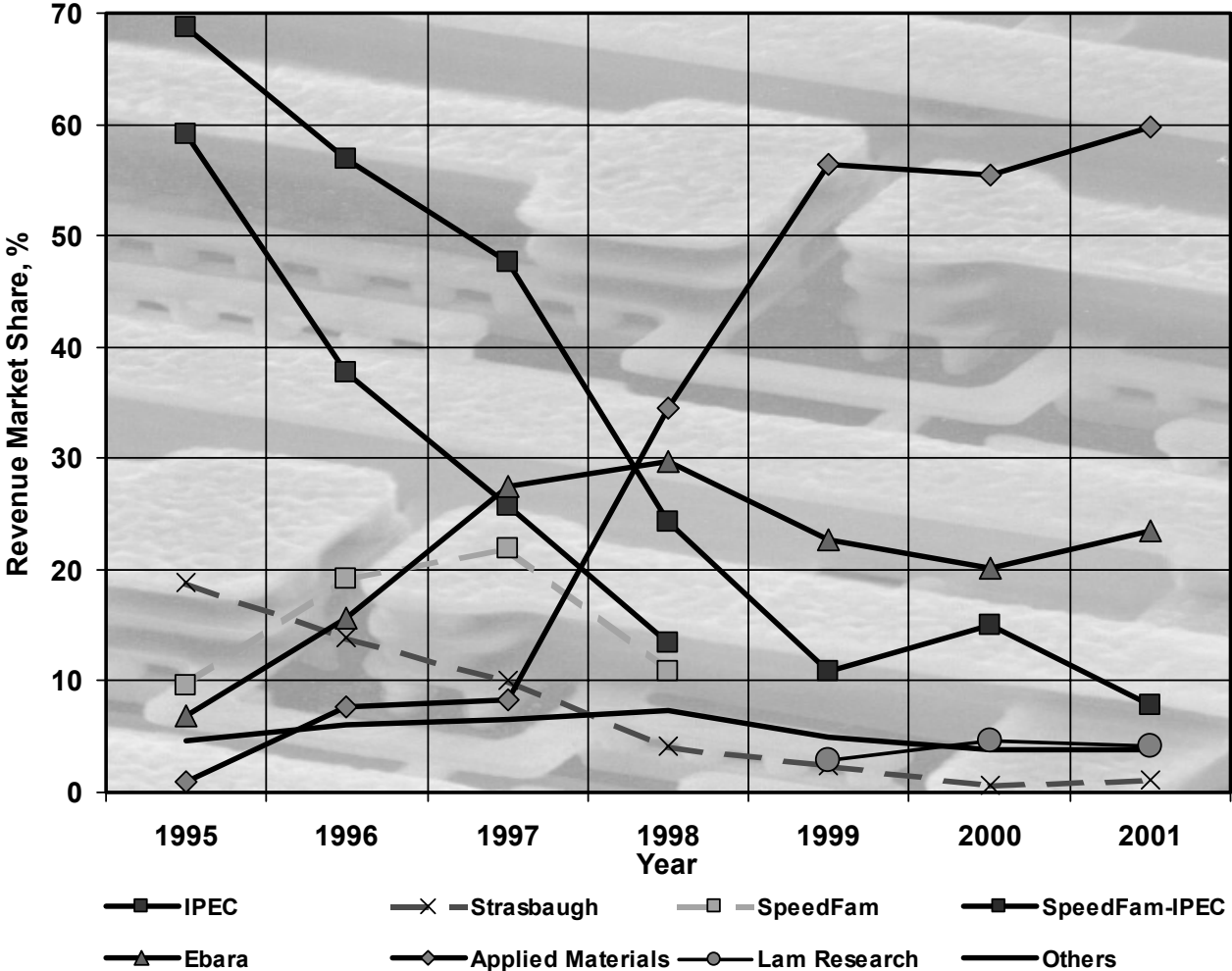


2001 Installed Base - 3795 Machines

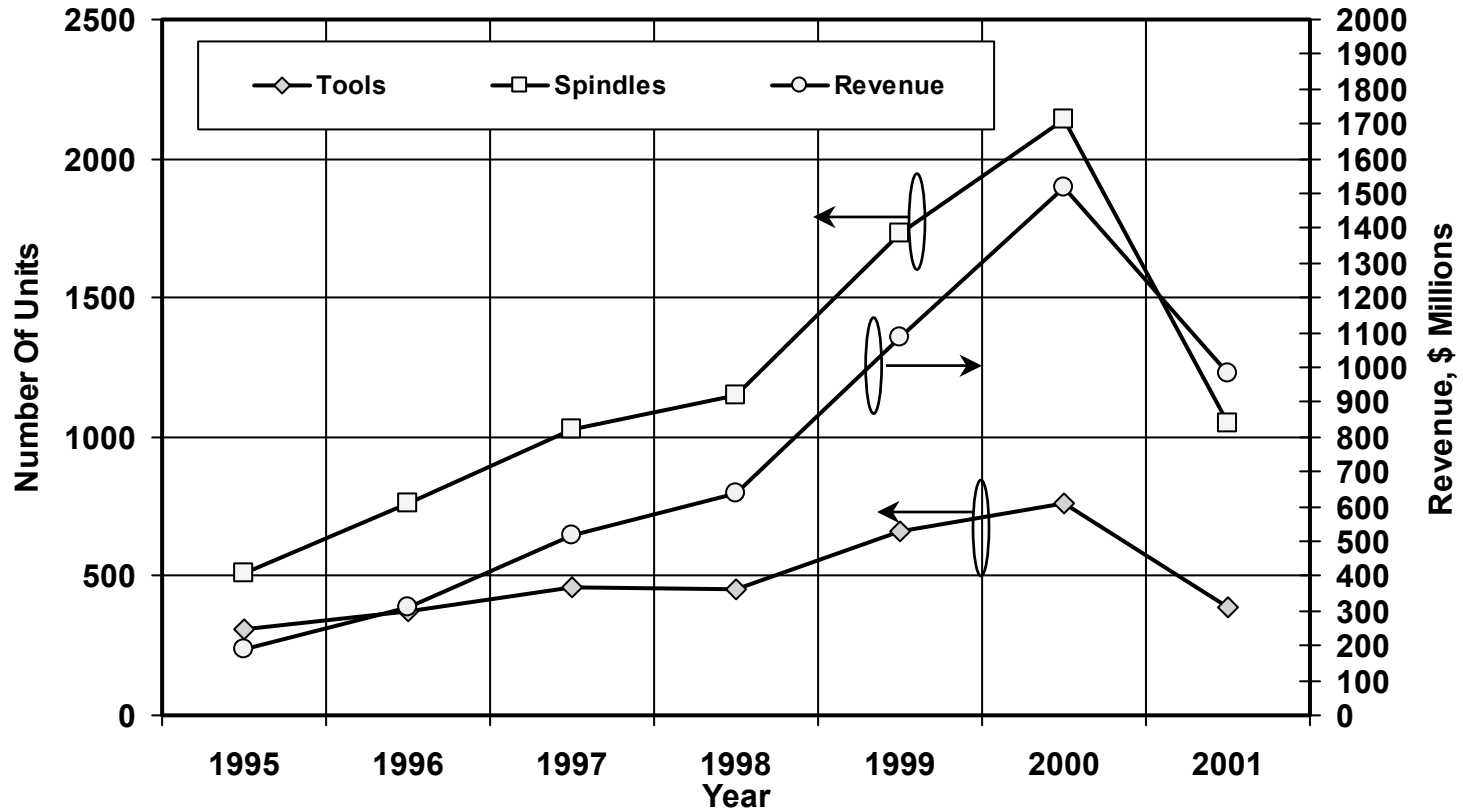


2001 Shipments - 385 Machines

# CMP Market Share Trends 1995 - 2001

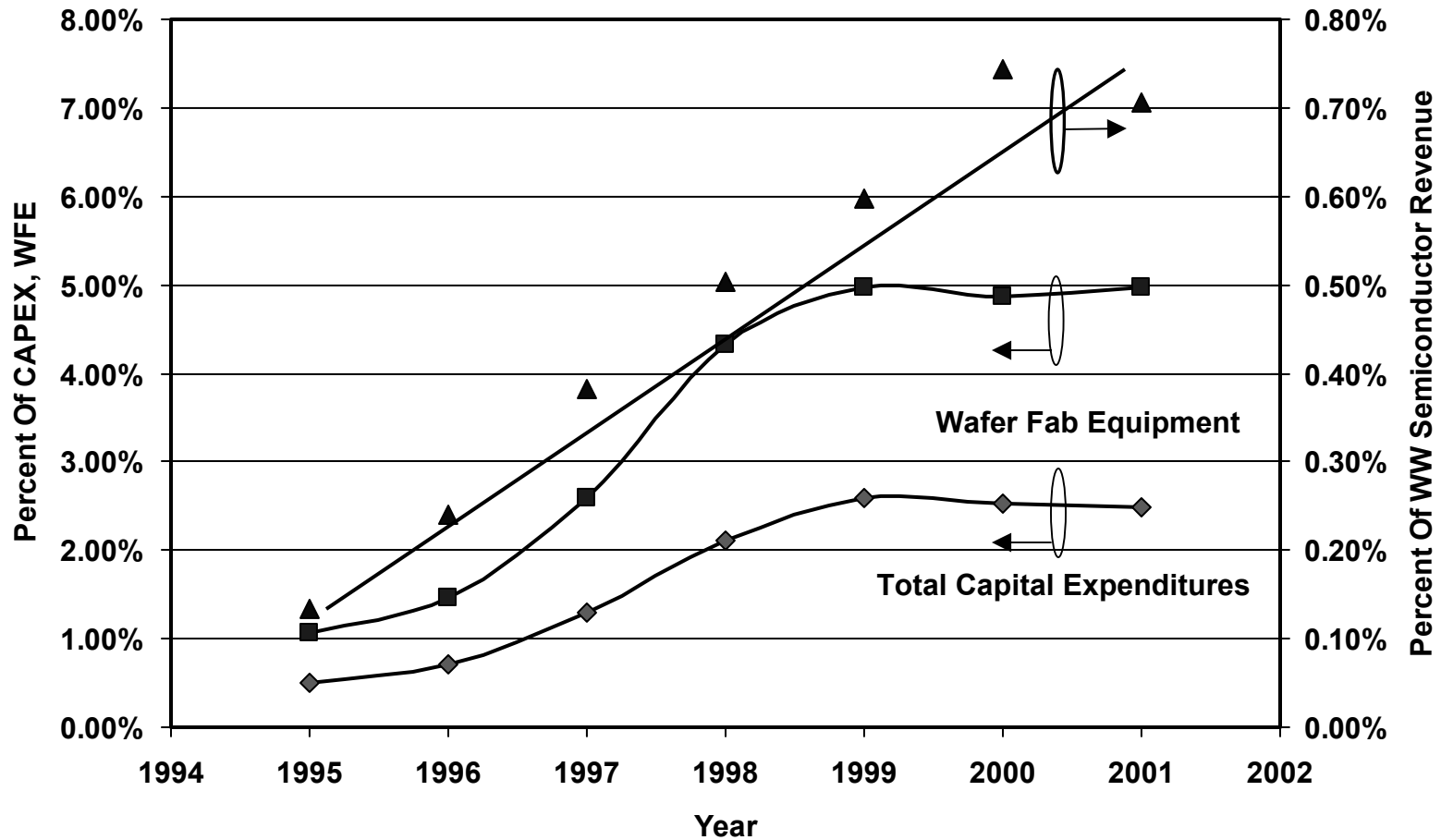


# CMP Market Changes: 1995 - 2001



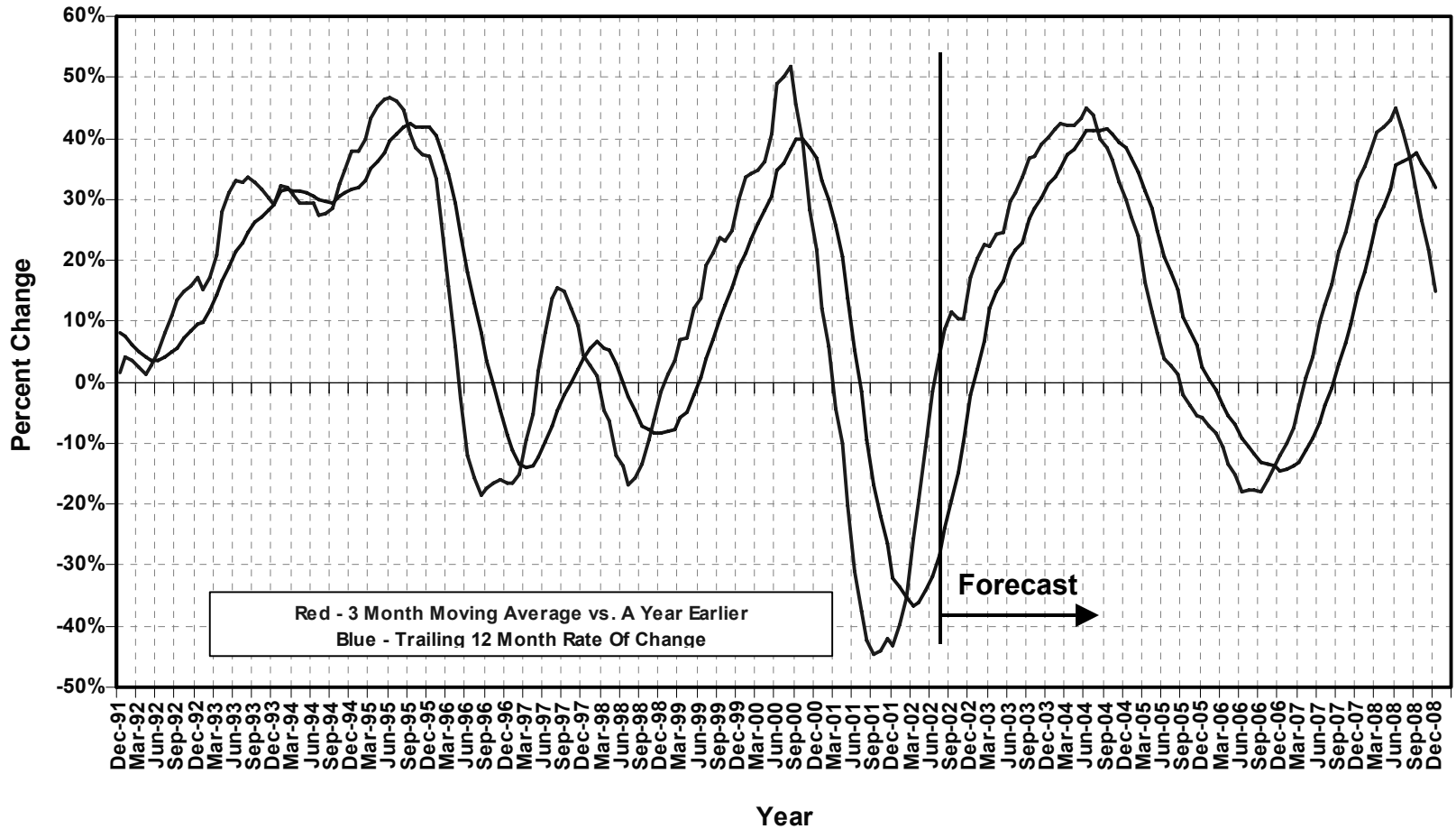
- ❖ Transition From Single Spindle To Multiple Spindle Units
- ❖ Transition From Standalone Units To Dry-In Dry-Out Systems
- ❖ Incorporation Of Onboard Or Inline Metrology On CMP Systems
- ❖ Advanced Carrier Designs
- ❖ More Sophisticated Control Systems
- ❖ Overbuying in 1998 – 2000

# CMP Revenue As A Percent Of CAPEX, WFE And Global Semiconductor Revenues (Adjusted)



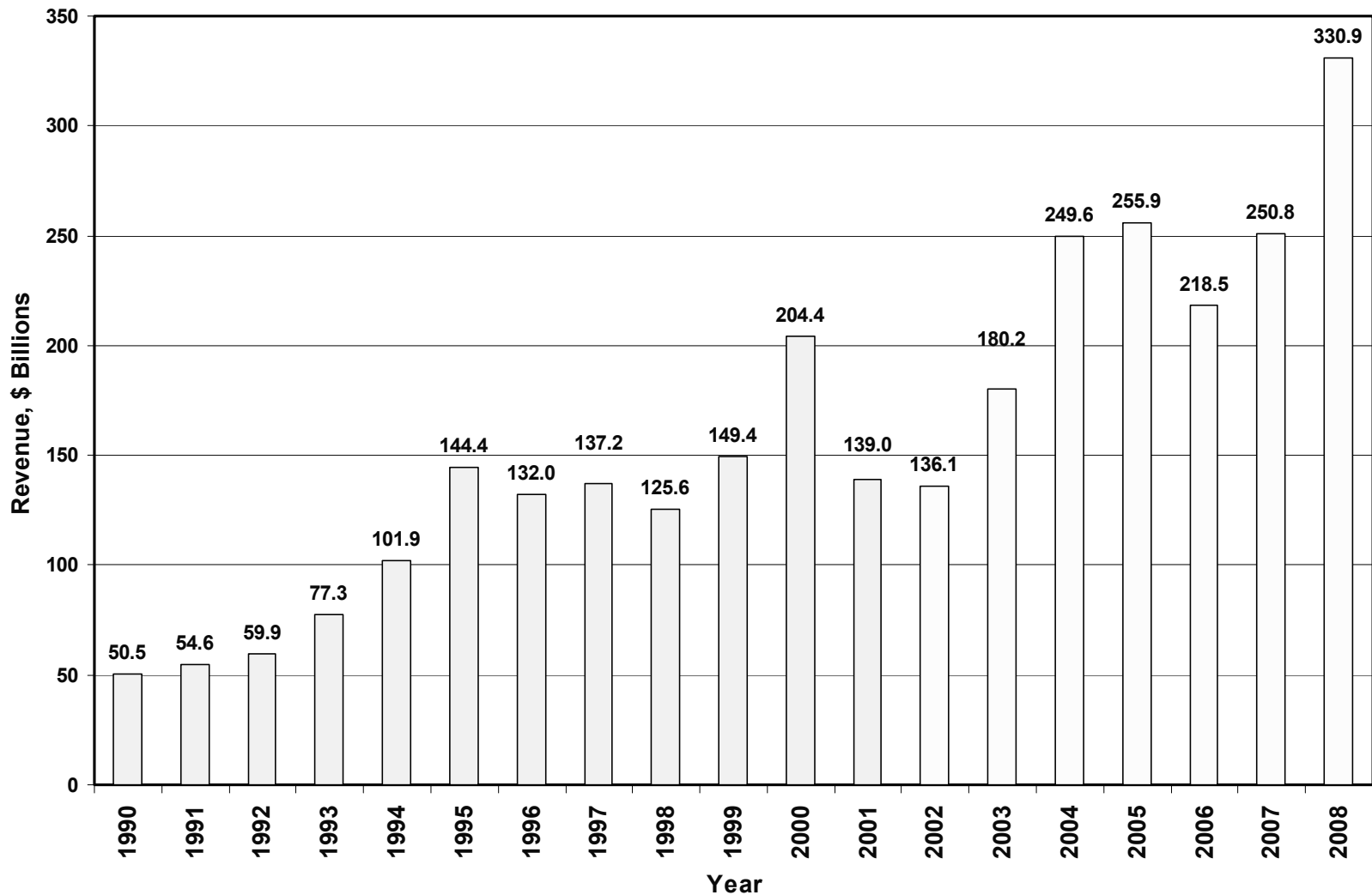


# Global Semiconductor Revenue Trailing Twelve Month Growth Rate And Percent Change In Three Month Revenue Moving Average Vs. The Year Earlier Comparable Period (Forecast)

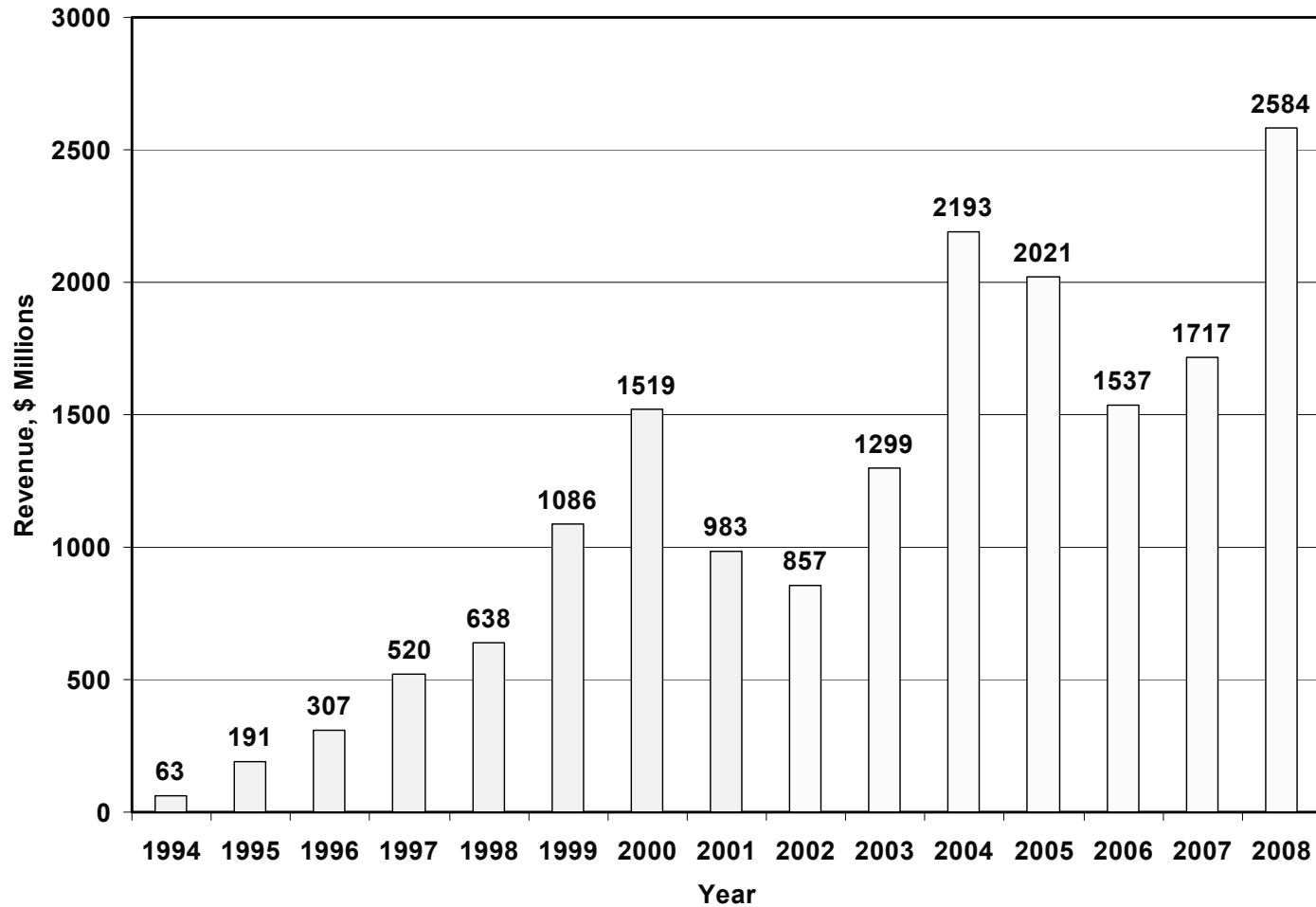


Source: WSTS Data

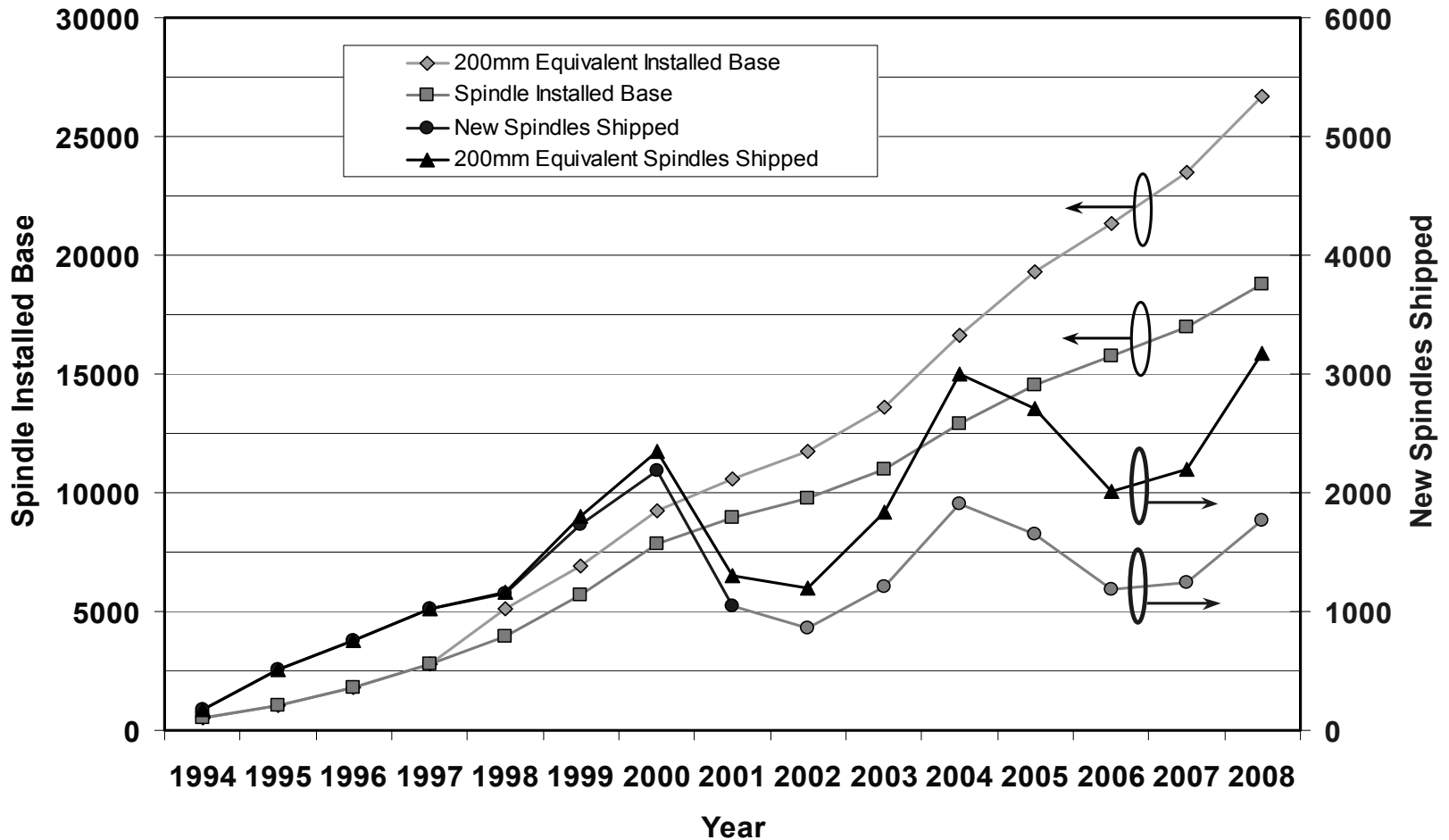
# Semiconductor Industry Revenues: History And Forecast



# CMP Equipment Markets: 1994-2008



# CMP Spindle Shipments And Installed Base: 1994-2008 (With 200mm Spindle Equivalents)

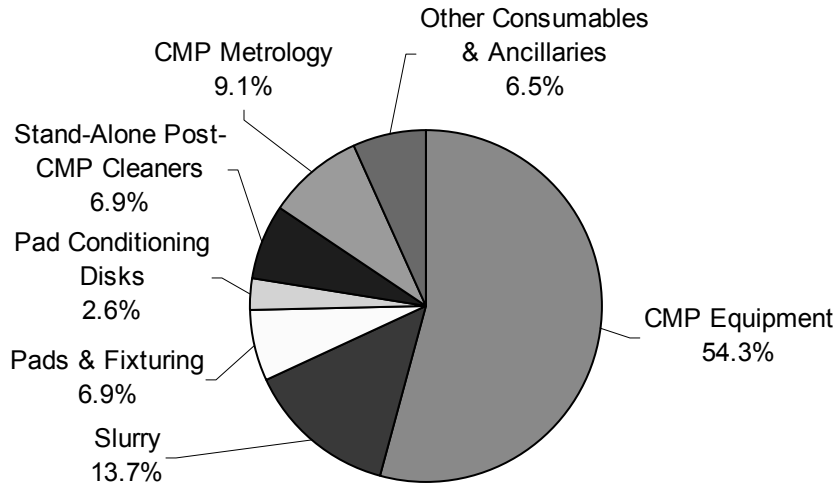


## Summary Of CMP Market Segments: 1994 - 2008

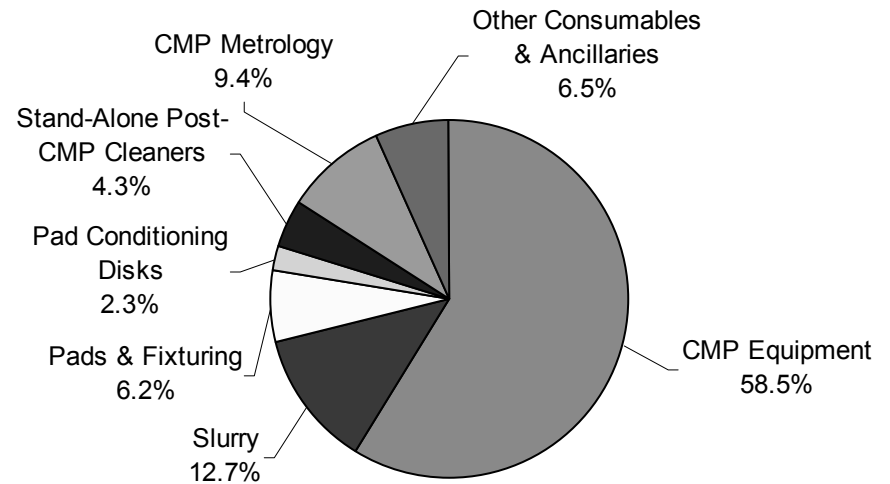
Market Segments, \$ Millions	1994	1995	1996	1997	1998	1999	2000	2001	2002
<b>CMP Equipment</b>	63.0	191.3	307.4	520.1	638.4	1085.7	1518.7	982.8	857.0
200mm Cu CMP	-	-	-	26.2	73.3	143.8	154.0	268.3	239.1
300mm Cu CMP	-	-	-	0.0	0.0	8.9	17.0	105.3	178.2
<b>Total Cu CMP</b>	-	-	-	26.2	73.3	152.7	171.1	373.6	417.3
Cu CMP Percent Of Total	-	-	-	5.0%	11.5%	14.1%	11.3%	38.0%	48.7%
Percent 300mm	-	-	-	-	0.9%	4.9%	9.9%	27.9%	42.6%
300mm CMP Equipment Revenue	-	-	-	-	5.6	53.1	150.0	274.3	364.8
<b>Slurry</b>	17.1	39.0	63.7	111.9	160.6	217.1	328.7	330.0	408.1
<b>Pads &amp; Fixturing</b>	6.2	15.2	28.3	53.5	81.5	110.9	160.8	151.4	187.7
Pad Conditioning Disks	2.2	5.6	10.4	19.9	30.3	41.3	59.9	56.8	70.7
Stand-Alone Post-CMP Cleaners	17.7	50.4	76.5	88.0	81.5	101.3	112.5	30.0	24.2
<b>CMP Metrology</b>	12.5	37.5	60.4	88.7	107.2	176.6	243.7	141.3	136.7
<b>Other Consumables &amp; Ancillaries</b>	8.3	23.7	38.3	61.8	77.0	121.3	169.7	118.5	117.9
<b>Total CMP Markets</b>	127.0	362.8	585.0	943.9	1176.6	1854.3	2594.1	1810.7	1802.5
Market Segments, \$ Millions	2001	2002	2003	2004	2005	2006	2007	2008	
<b>CMP Equipment</b>	982.8	857.0	1298.6	2193.1	2020.6	1536.7	1716.9	2583.9	
200mm Cu CMP	268.3	239.1	311.4	458.8	365.3	245.9	254.2	345.3	
300mm Cu CMP	105.3	178.2	369.6	702.2	704.0	557.5	678.2	1032.0	
<b>Total Cu CMP</b>	373.6	417.3	681.0	1161.0	1069.3	803.4	932.4	1377.3	
Cu CMP Percent Of Total	0.4	48.7%	52.4%	52.9%	52.9%	52.3%	54.3%	53.3%	
Percent 300mm	0.3	42.6%	54.1%	60.2%	65.8%	69.5%	72.5%	74.9%	
300mm CMP Equipment Revenue	274.3	364.8	702.8	1320.8	1329.1	1067.9	1245.4	1935.8	
<b>Slurry</b>	330.0	408.1	514.3	653.3	786.1	887.6	966.5	1068.0	
<b>Pads &amp; Fixturing</b>	151.4	187.7	238.7	288.8	340.5	370.6	389.4	413.2	
Pad Conditioning Disks	56.8	70.7	90.0	110.0	130.7	142.8	150.3	160.8	
Stand-Alone Post-CMP Cleaners	30.0	24.2	34.9	55.7	49.6	36.4	40.0	58.4	
<b>CMP Metrology</b>	141.3	136.7	210.9	364.7	346.9	272.3	313.3	488.4	
<b>Other Consumables &amp; Ancillaries</b>	118.5	117.9	167.1	256.6	257.2	227.2	250.3	334.1	
<b>Total CMP Markets</b>	1810.7	1802.5	2554.5	3922.1	3931.5	3473.6	3826.7	5106.7	

# Distribution Of CMP Revenues By Segment

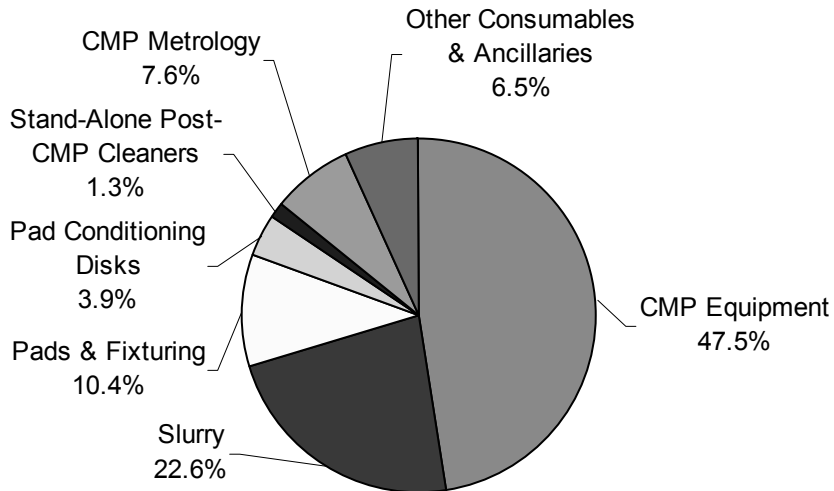
## 1998 CMP Segment Shares



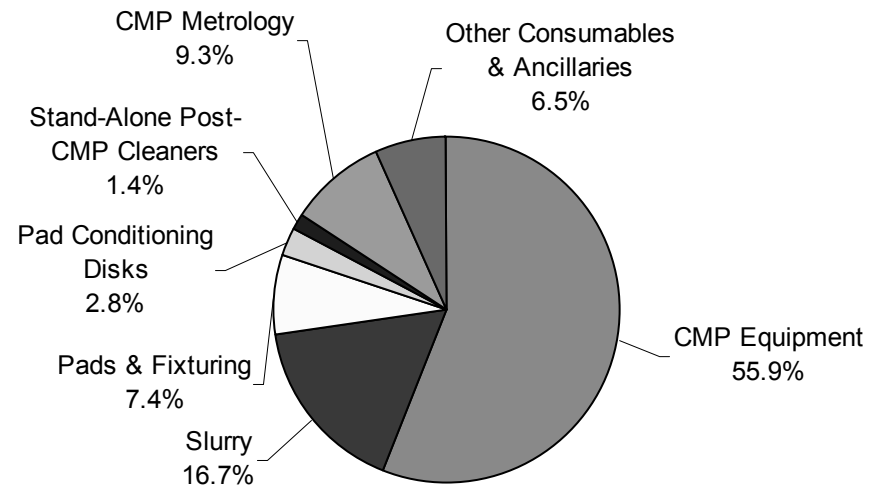
## 2000 CMP Segment Shares



## 2002 CMP Segment Shares

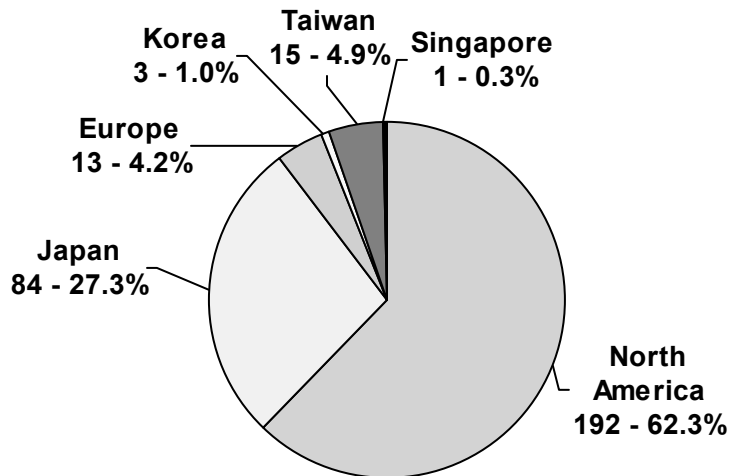


## 2004 CMP Segment Shares

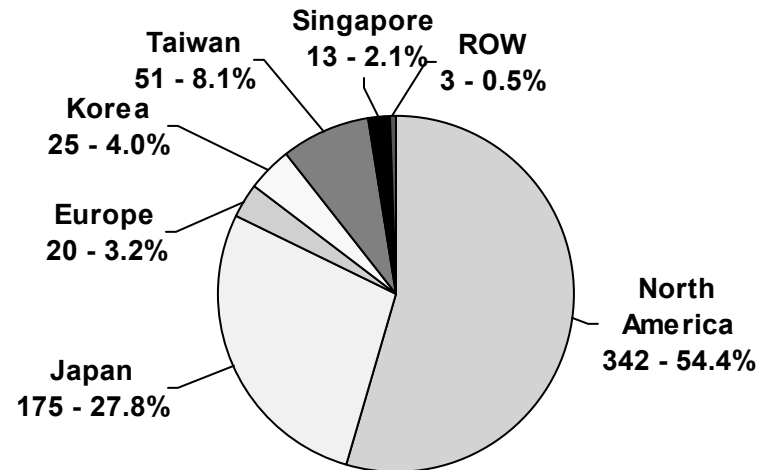


# US CMP Related Patents Issued By Geographic Region Of Assignee

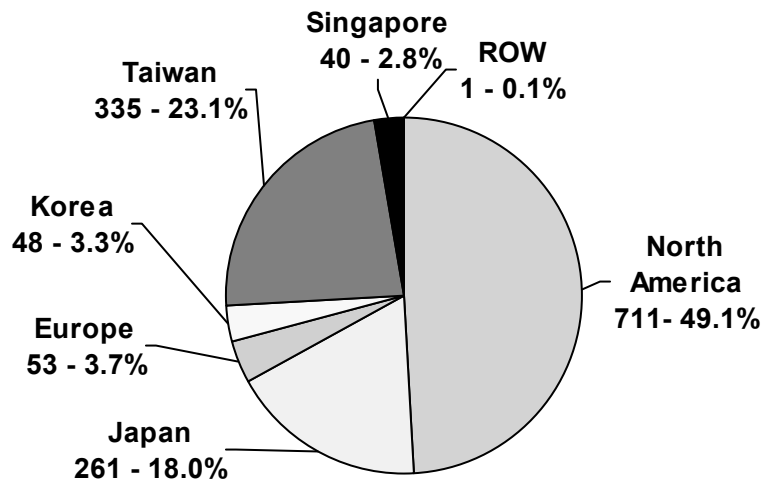
1995 - 308 Patents



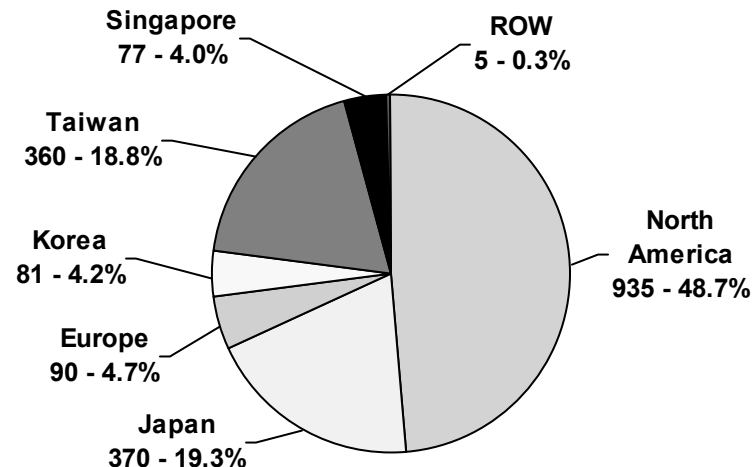
1997 - 629 Patents



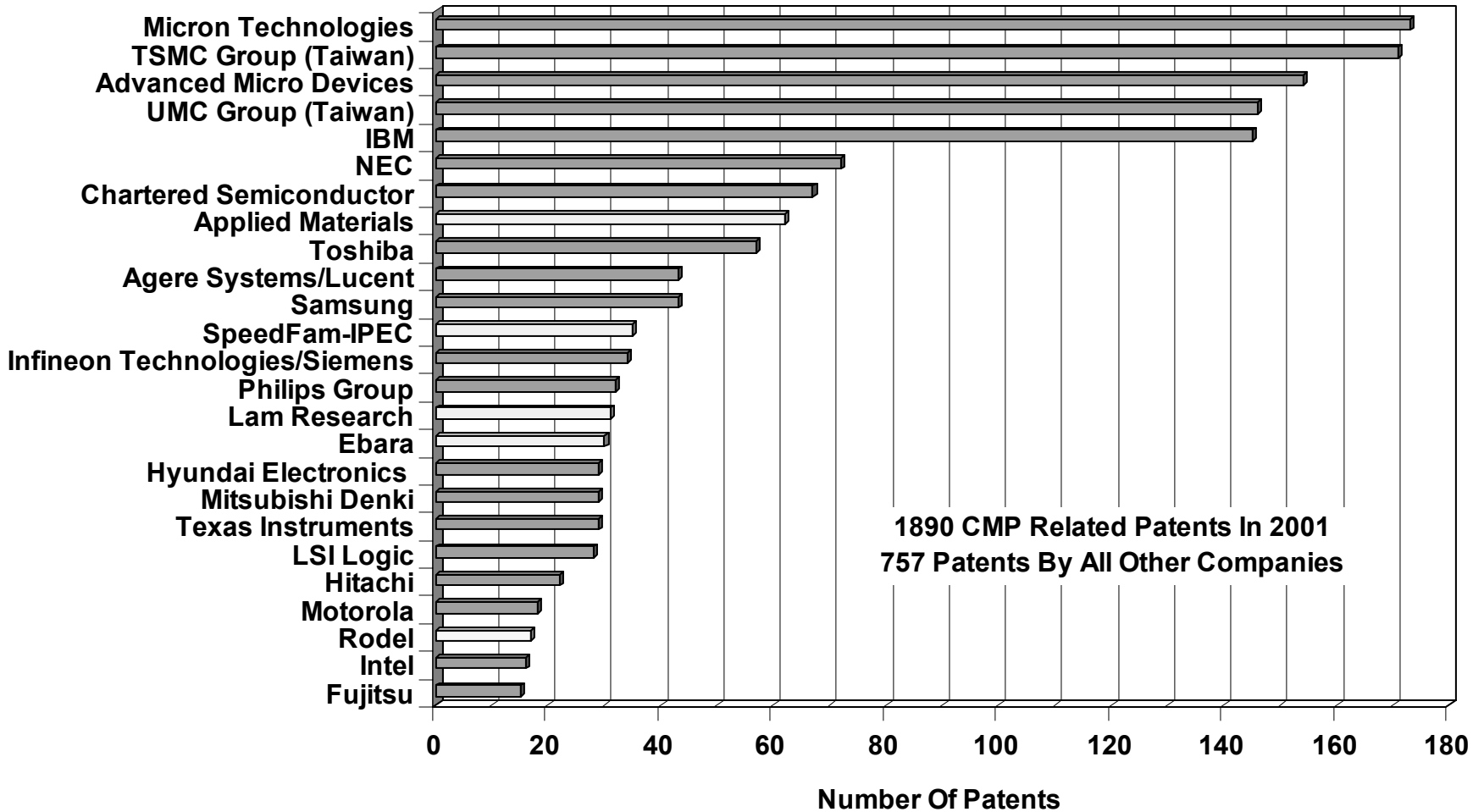
2000 - 1449 Patents



2001 - 1890 Patents



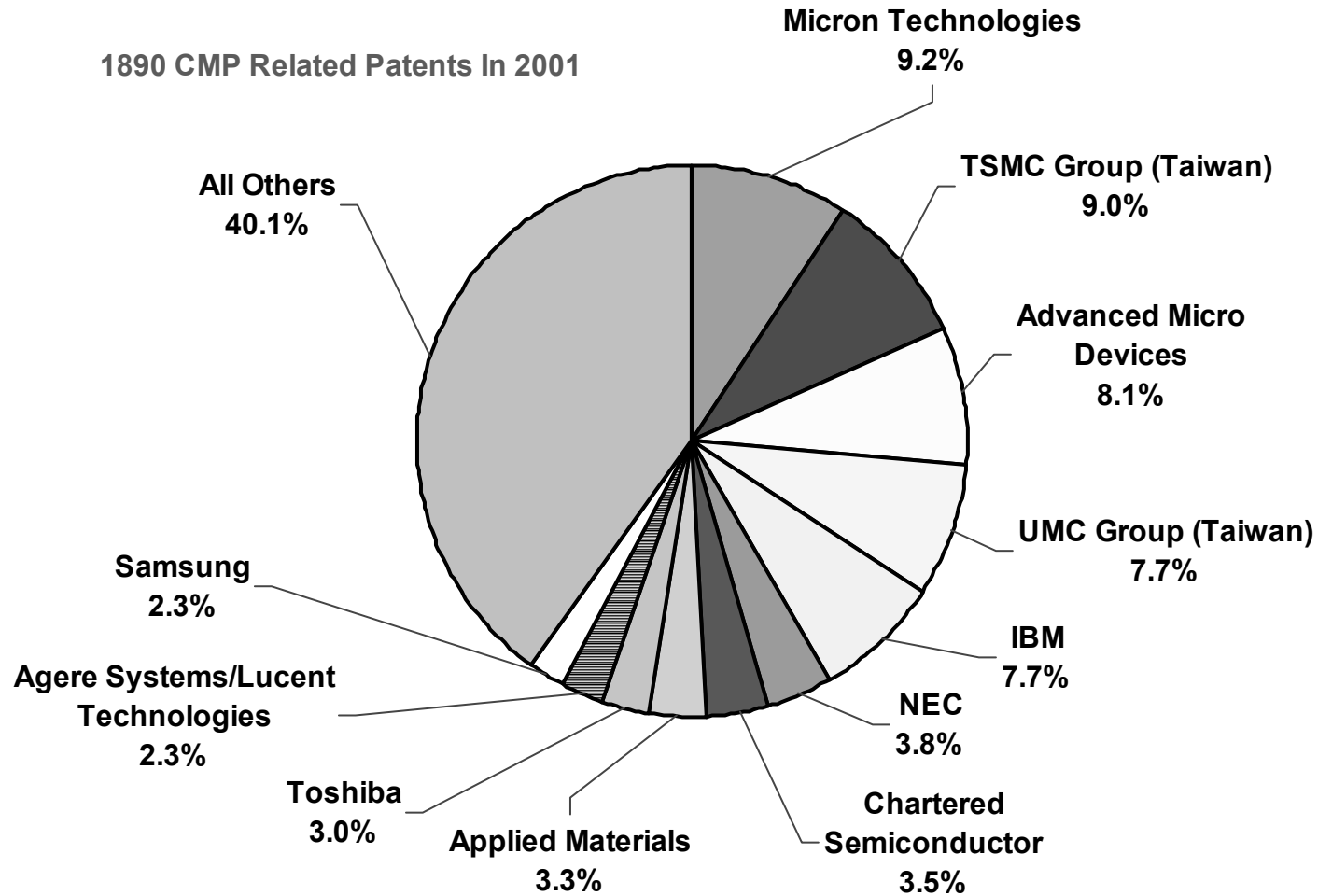
# 2001 US CMP Related Patents By Company



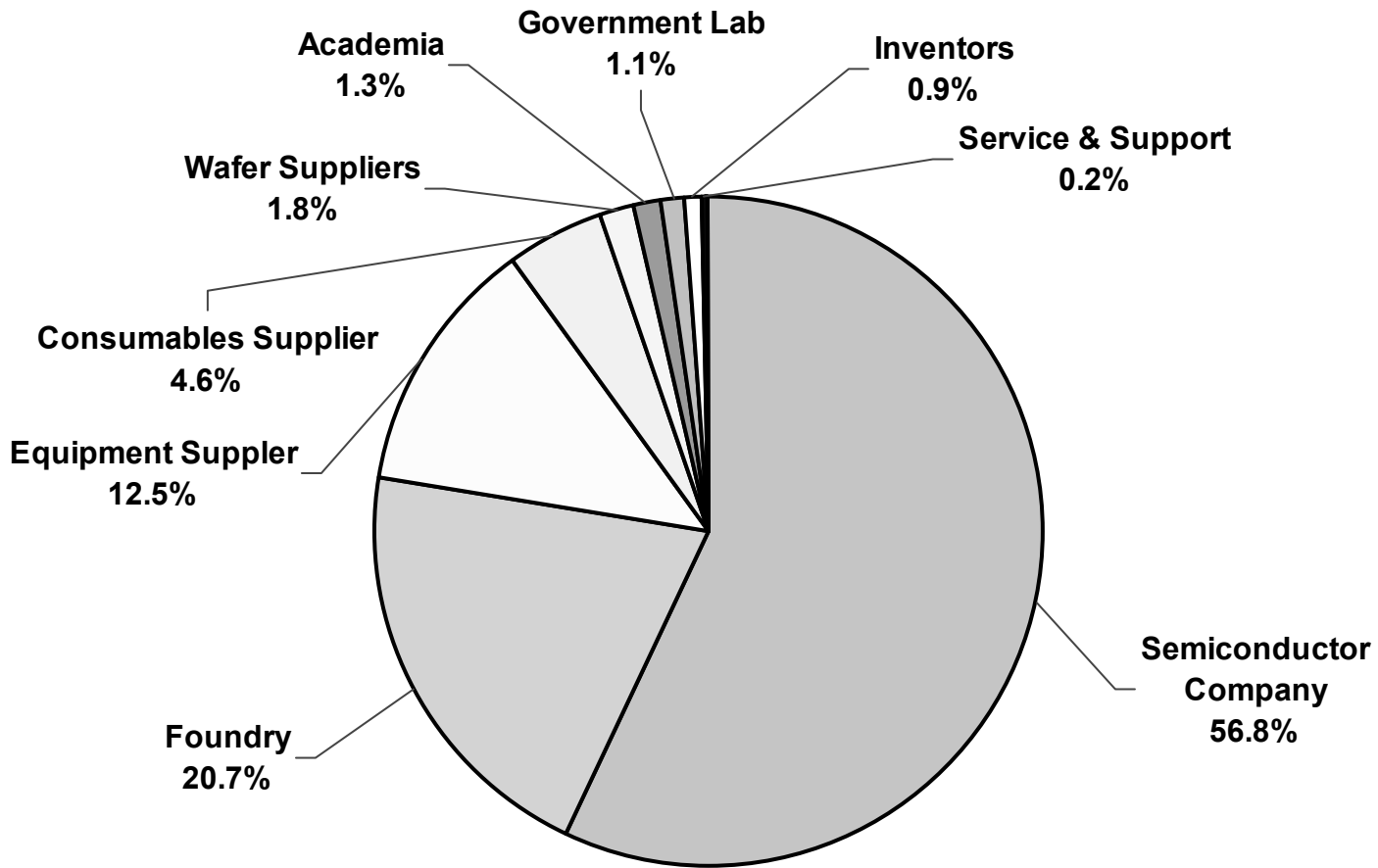


# Distribution Of 2001 CMP Patents

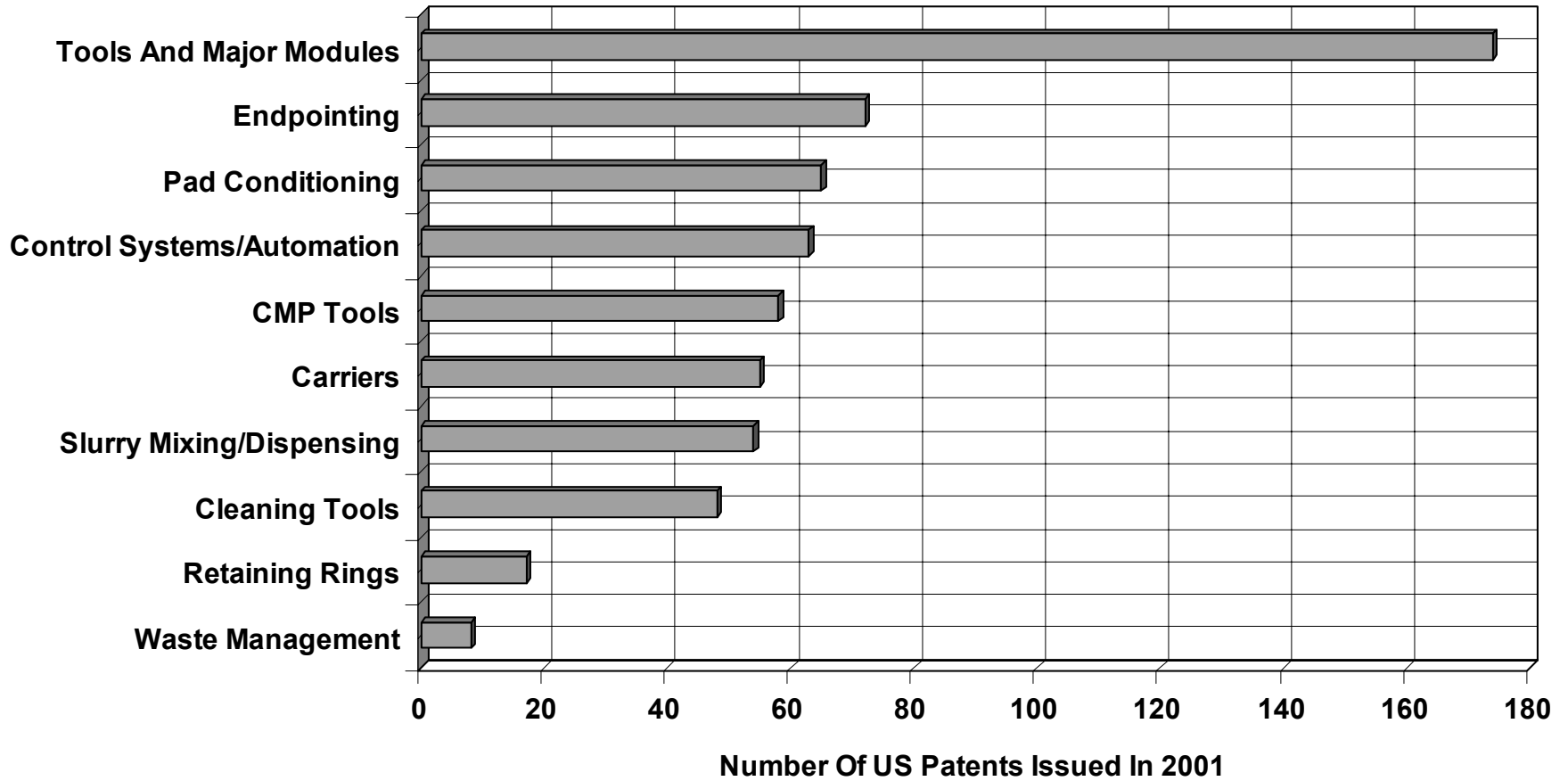
1890 CMP Related Patents In 2001



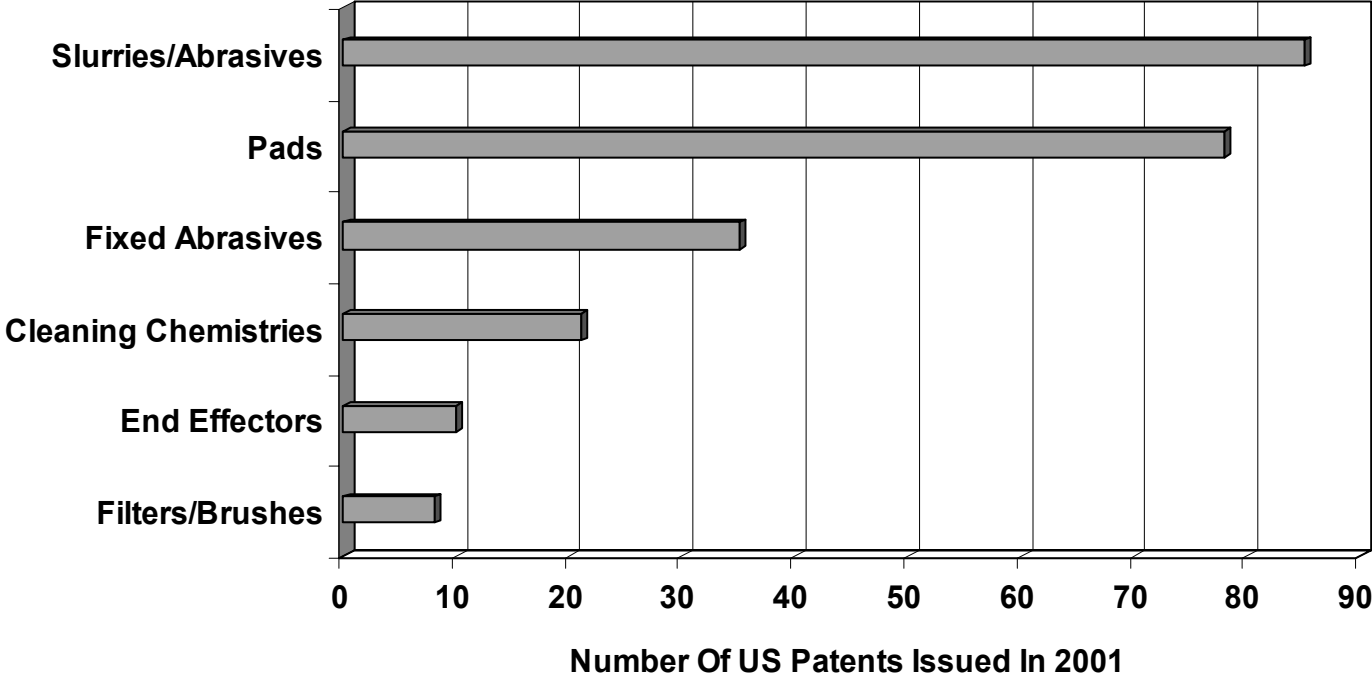
# US CMP Related Patents Issued In 2001 By Type Of Assignee



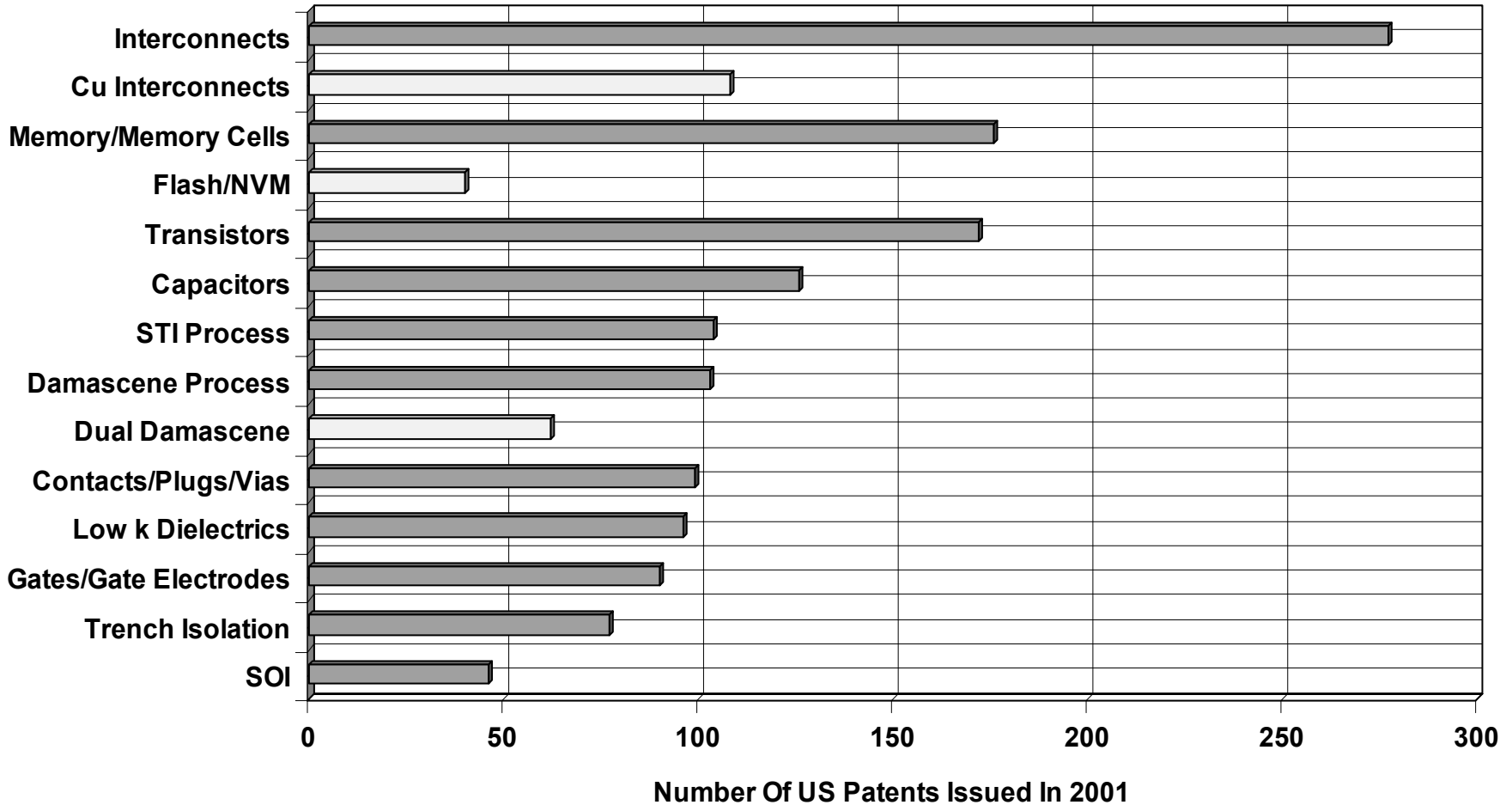
# CMP Related Apparatus Patents



# CMP Related Consumables Patents

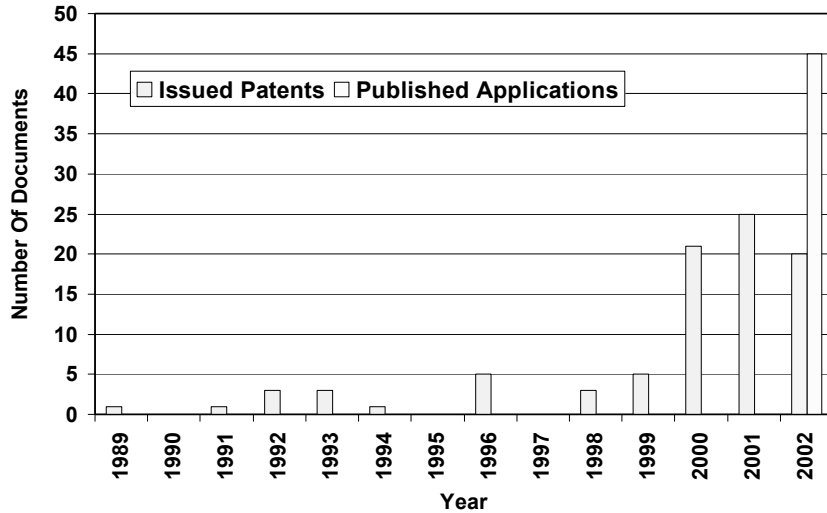


# CMP Related Process Patents

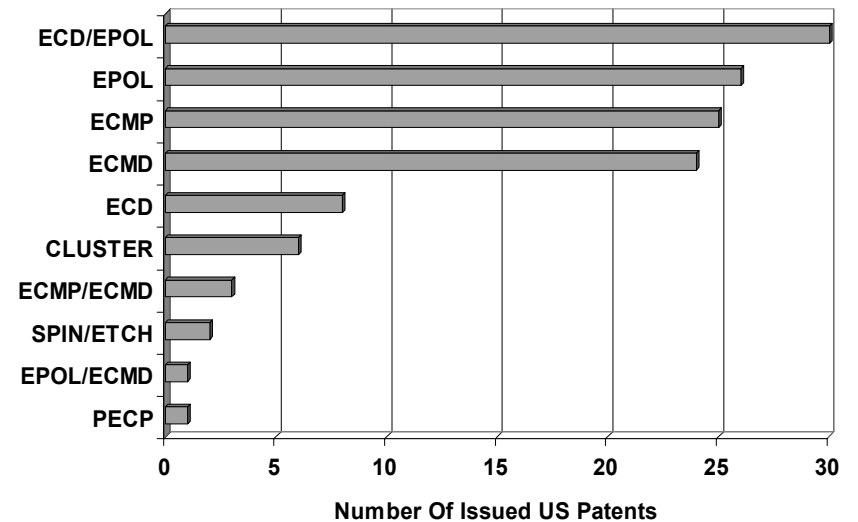


# Electrolytic Processes Used For Planarization

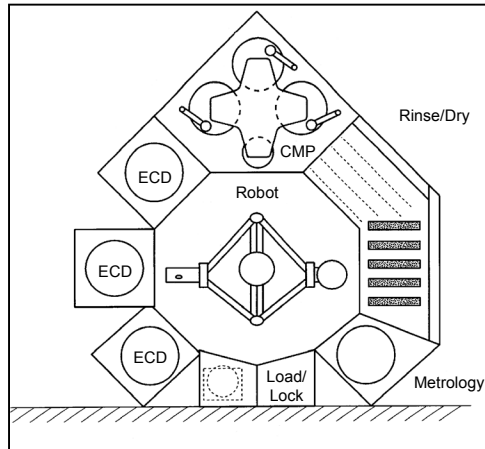
Electrolytic Planarization Patents Issued By Year



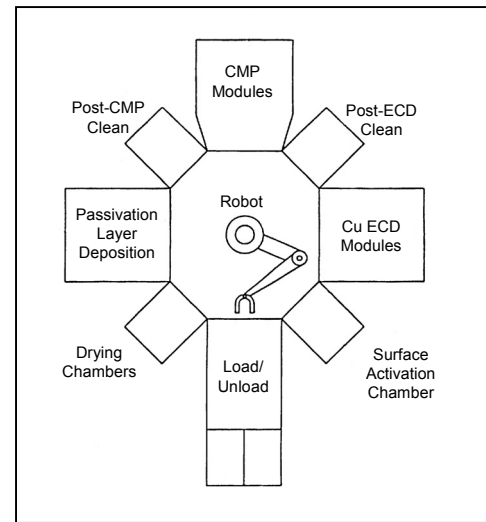
Electrolytic Planarization Patents By Category



# Cluster Tool Approach – Copper Metallization Module

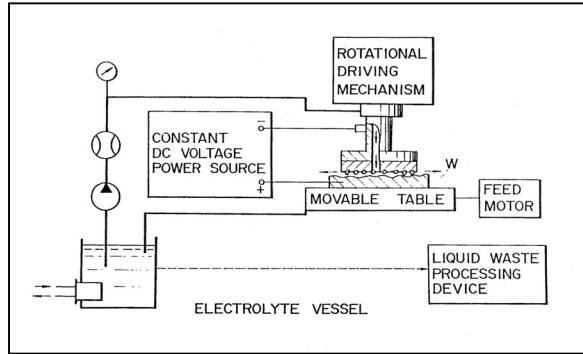


Applied Materials Concept

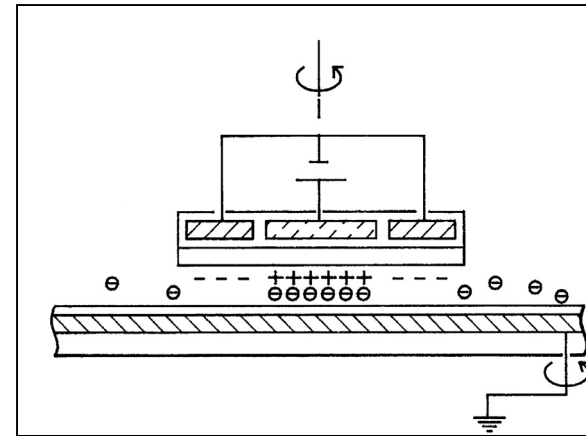


Ebara Concept

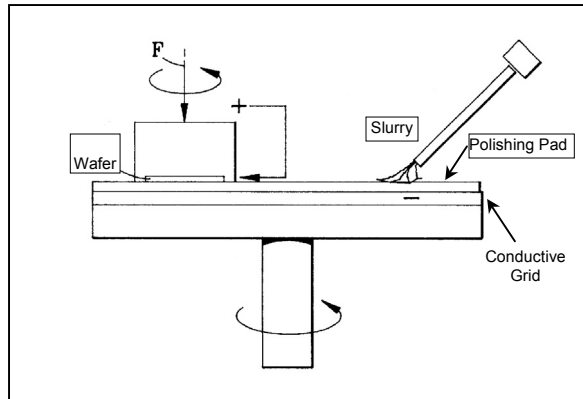
# Electrolytically Assisted CMP



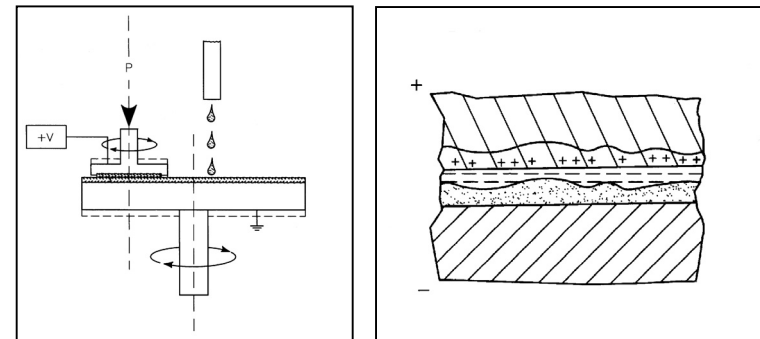
Kobe Seiko US patent 4839005  
issued on June 13, 1989



TSMC US patent 5575706  
issued November 19, 1996



IBM US patent 5807165 issued  
on September 15, 1998



Micron Technology US patent 6010964  
issued on January 4, 2000



# CMP Tool Generations

Tool Generation	Time Period	Wafer Size, mm	Kinematics	Throughput, wph	Carrier Technology	Tool Process Capability	Metrology
1	1984-1994	100-200	Rotary	10	Fixed Plate	Dry-In Wet-Out 1 Step CMP + Buff Clean Single Wafer 10mm Edge Exclusion	Motor Current EPD
2	1993-1999	125-200	Rotary Orbital Carousel	20	Fixed Plate Back Pressure Active Retaining Ring	Dry-In Wet-Out 1 Step CMP + Buff Clean Multiple Wafers 6mm Edge Exclusion	Motor Current EPD In Line Optical Metrology
3	1998-2003	200-300	Rotary Orbital Linear	35	Active Retaining Ring Membrane Backing	Dry-In Dry-Out Multiple Step+Buff Clean Multiple Wafers 3mm Edge Exclusion	In Line Optical Metrology Run-To-Run Control In-situ Optical EPD Acoustic Monitor EPD Chemiluminescence EPD
4	2001-	200-300	Rotary Orbital Linear Elliptical	50	Active Retaining Ring Membrane Backing Zone Pressure Control	Dry-In Dry-Out Multiple Step+Buff Clean Multiple Wafers ≤2mm Edge Exclusion	In Line Optical Metrology Adaptive Process Control Coefficient Of Friction EPD In-situ Optical EPD Acoustic Emission EPD Chemiluminescence EPD Eddy Current EPD
5	2003-	300	Rotary Orbital Linear Elliptical	50	Active Retaining Ring Membrane Backing Zone Pressure Control	Dry-In Dry-Out Multiple Step+Buff Clean Multiple Wafers ≤2mm Edge Exclusion Integration With Electroplating Module And Rapid Thermal Anneal Electrically Enhanced CMP	In Line Optical Metrology Adaptive Process Control Coefficient Of Friction EPD In-situ Optical EPD Acoustic Emission EPD Chemiluminescence EPD Eddy Current EPD

## Conclusions

- ❖ **CMP Market Segments Have Been Severely Impacted During The Current Downturn**
- ❖ **Consumables Segments And Leading Edge Technology Have Been Impacted By The Downturn To A Lesser Degree**
- ❖ **Market Share Rankings Remained Unchanged During 2001**
- ❖ **CMP Market Segments Will Grow At The Same Rate As The Overall Equipment Market Going Forward**
- ❖ **Growth Rates For Semiconductor Revenues Are Slowing While Technology Becomes More Complex And Challenging**
- ❖ **ECMP, ECD or Electropolishing Technologies Have The Potential To Reshape The Equipment And Consumables Markets For Planarization Of Advanced Interconnect Structures**