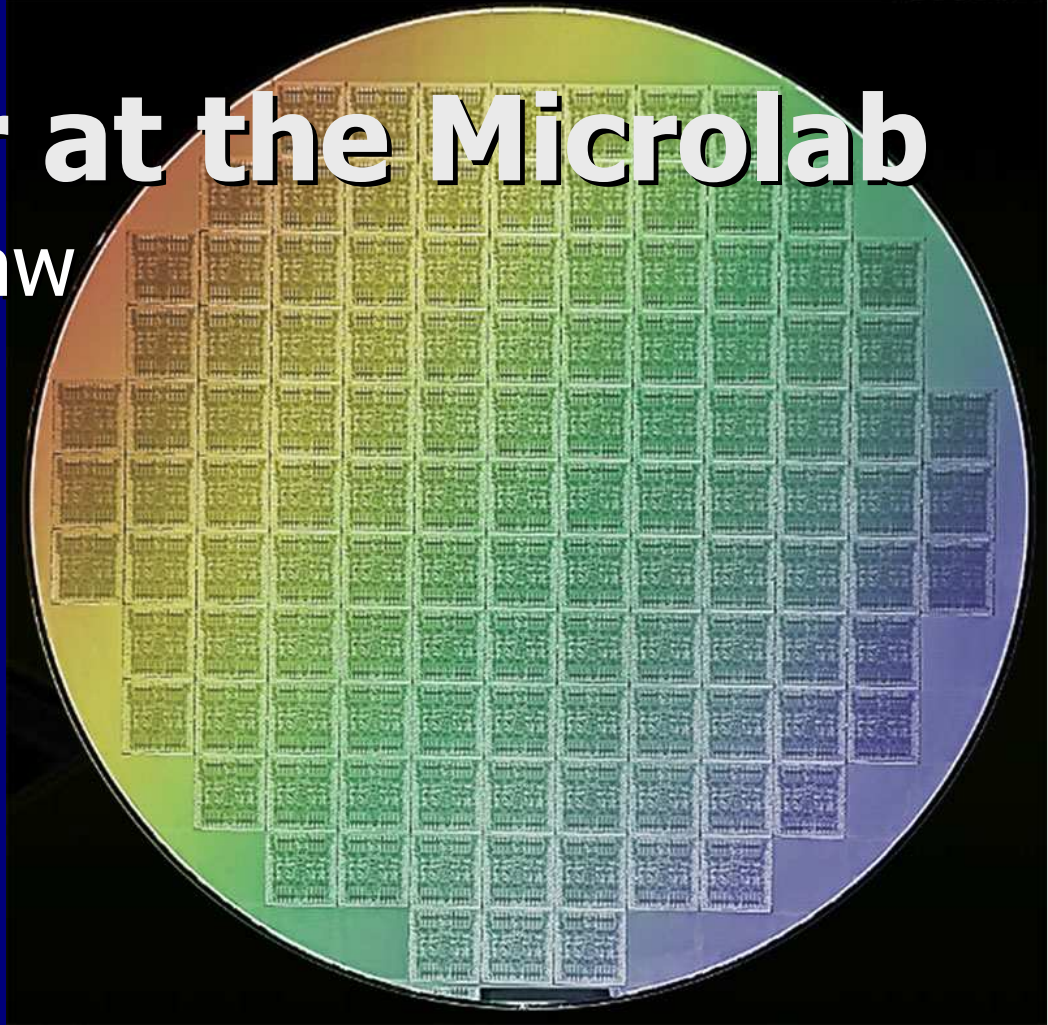


Summer at the Microlab

Kelsey Brokaw



Getting to Berkeley



Chemical **M**echanical **P**olisher

1. Chemical

Weaken the surface material to allow polishing

- Table Speed (rpm)
- Chuck Speed (rpm)
- Slurry Flow (ml/min)

2. Mechanical

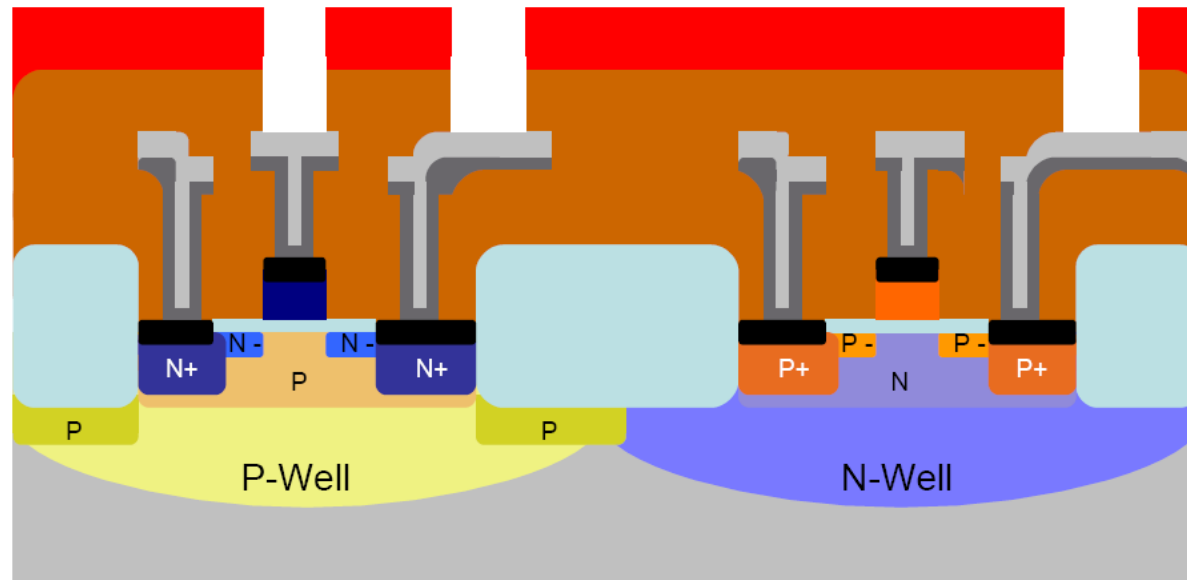
2 rotating wheels work like sand-paper



- Back Pressure (psi)
- Down Force (psi)
- Temperature (°C)
- Time (sec)
- Pad Down Force (lbs)
- Ring Force (psi)

You and the CMP

Via 1 Photo and Etch



- | | | | |
|-------------------|--------------|-------------------|----------|
| Silicon substrate | Poly-Silicon | TEOS | Titanium |
| Oxide | Photo resist | Titanium Silicide | Aluminum |

Attila Horvath ath
2005



Wafer Ca



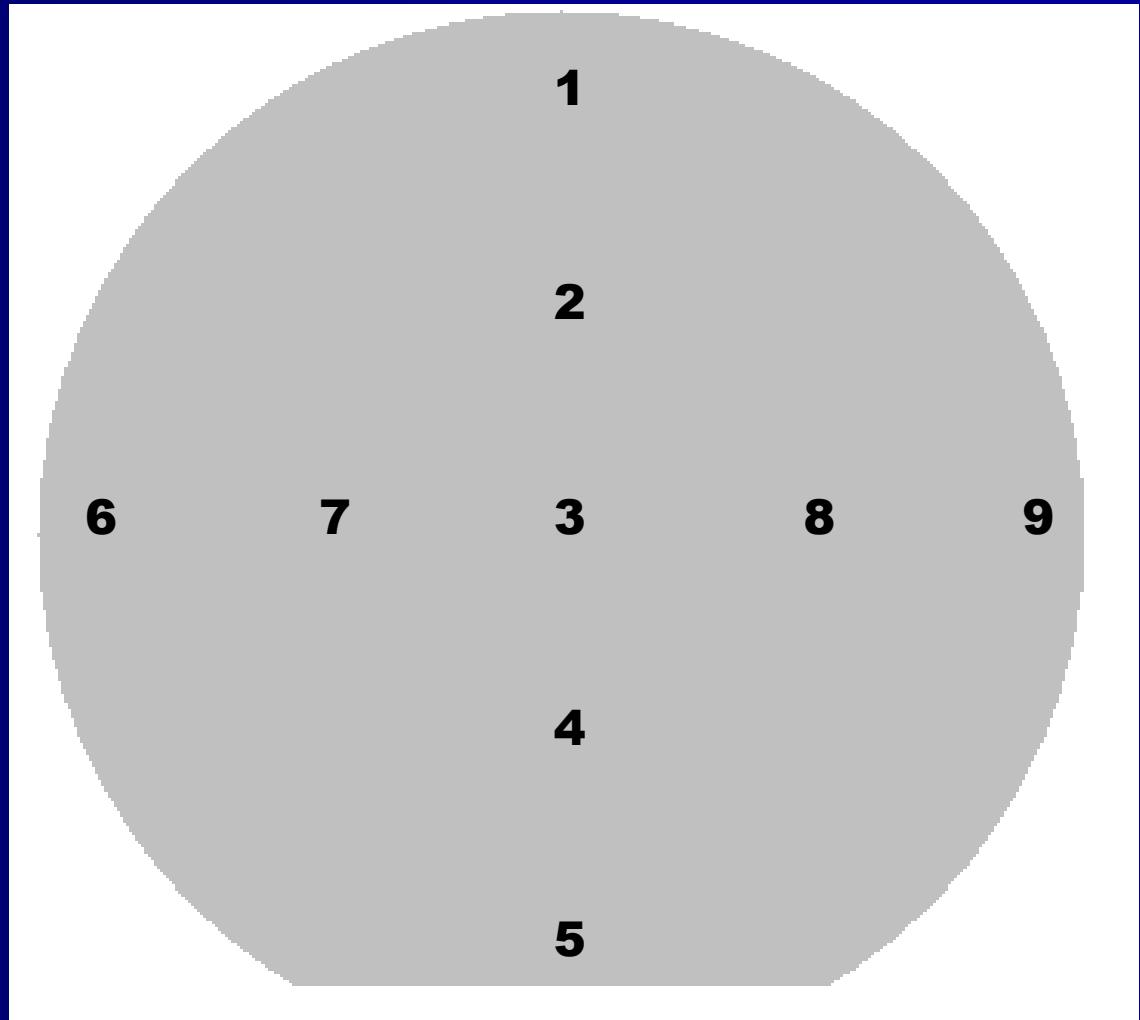
Wafer Surface

Goals

1. Used Pad – Better or Worse?
2. New Design – Faster, Better Polishing?
3. Settings – How do we optimize what we have?

Measuring

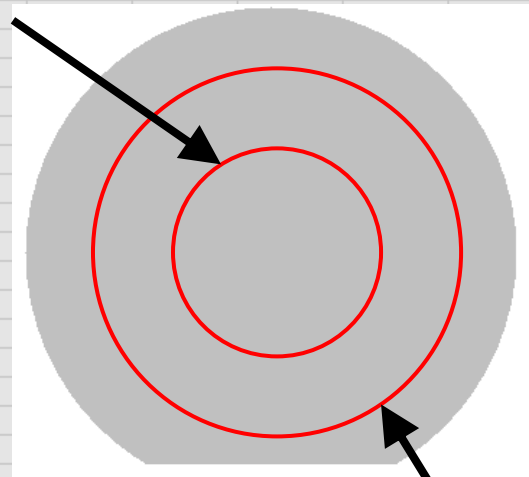
1. Top
2. Top Center
3. Center
4. Flat Center
5. Flat
6. Left
7. Left Center
8. Right Center
9. Right



| J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | AA | |
|------------|-------|-------|-------|---------|-------|-------|----------|---------|-------|-------|-------|---------|-------|-------|-------|------------|--------|--------|
| | | | | | | | 7/7/2008 | | | | | | | | | new pad | | |
| oxide6 std | | | | | | | | 2 psi | | | | 4 psi | | | | oxide6 std | | |
| ex-situ | | | | in-situ | | | | ex-situ | | | | ex-situ | | | | 60 sec. | | |
| 32 | 33 | | | | | | | 38* | 39 | 40 | | | | | | | 45 | |
| 7710 | 10334 | 10433 | 10323 | 10302 | 10265 | 10266 | 10247 | 10369 | 10434 | 10448 | | | | | | | 10569 | |
| 7572 | 10170 | 10270 | | 10302 | 10265 | 10266 | 10247 | 10306 | 10313 | | | | | | | | 10495 | |
| 7451 | 10012 | 10088 | | 10141 | 10097 | 10090 | 10090 | 10137 | 10154 | | | | | | | | 10333 | |
| 7338 | 9880 | 9958 | | 9985 | 9933 | 9926 | 9936 | 9978 | 9996 | | | | | | | | 10162 | |
| 7259 | 9763 | 9842 | | 9850 | 9792 | 9804 | 9802 | 9843 | 9859 | | | | | | | | 10042 | |
| 7653 | 10204 | 10288 | | 10323 | 10283 | 10263 | 10269 | 10302 | 10316 | | | | | | | | 10490 | |
| 7532 | 10099 | 10190 | | 10243 | 10187 | 10178 | 10170 | 10218 | 10227 | | | | | | | | 10405 | |
| 7379 | 9954 | 10007 | | 10045 | 9996 | 9992 | 10048 | 10055 | | | | | | | | | 10229 | |
| 7336 | 9895 | 9987 | | 10036 | 9994 | 9993 | 9923 | 9974 | 9987 | | | | | | | | 10134 | |
| 7470 | 10035 | 10117 | | 10145 | 10096 | 10092 | 10089 | 10138 | 10151 | | | | | | | | 10318 | |
| 6.0% | 5.7% | 5.8% | | 5.9% | 6.0% | 5.6% | 5.6% | 5.8% | 5.8% | | | | | | | | 5.1% | |
| 5370 | 8460 | 8733 | | 8413 | 8472 | 8579 | 8519 | 8720 | 8789 | | | | | | | | 10140 | |
| 5649 | 8316 | 8411 | | 8166 | 8238 | 8238 | 7923 | 8418 | 8420 | | | | | | | | 10318 | |
| 5400 | 8181 | 8207 | | 8086 | 8275 | 8140 | 7414 | 8065 | 8351 | | | | | | | | 10181 | |
| 5421 | 8234 | 7705 | | 7520 | 7710 | 7710 | 7820 | 7920 | 7920 | | | | | | | | 9932 | |
| 5121 | 7968 | 8373 | | 7839 | 8139 | 8144 | 8137 | 816 | 816 | | | | | | | | 9713 | |
| 5573 | 8217 | 8331 | | 8381 | 8336 | 8243 | 8133 | 8630 | 8564 | | | | | | | | 10042 | |
| 5639 | 8217 | 8331 | | 8381 | 8336 | 8243 | 8133 | 8630 | 8564 | | | | | | | | 10150 | |
| 5326 | 8385 | 8516 | | 8021 | 8360 | 8423 | 7919 | 8404 | 8364 | | | | | | | | 10031 | |
| 4953 | 7737 | 7870 | | 7969 | 7639 | 7765 | 7338 | 7805 | 8195 | | | | | | | | 9687 | |
| 5384 | 8208 | 8316 | | 8077 | 8189 | 8189 | 7686 | 8288 | 8342 | | | | | | | | 10022 | |
| 2340 | 1874 | 1650 | | 1954 | 1996 | 1983 | 1806 | 1929 | 3004 | 1953 | 1903 | 2286 | 1768 | 1867 | 1849 | 1828 | 187 | 429 |
| 1923 | 1854 | 1537 | | 1771 | 1891 | 1793 | 1689 | 1791 | 1928 | 1586 | 1524 | 1679 | 1607 | 1538 | 1520 | 1555 | 40 | 177 |
| 2051 | 1831 | 1677 | | 1853 | 1939 | 1939 | 1995 | 2167 | 1720 | 1734 | 1873 | 1645 | 1634 | 1646 | 1642 | 1642 | 67 | 152 |
| 1917 | 1646 | 1751 | | 1771 | 1820 | 1820 | 1781 | 2522 | 1913 | 1645 | 2027 | 1555 | 1542 | 1666 | 1588 | 1588 | 102 | 230 |
| 2139 | 1795 | 2137 | | 2023 | 2327 | 1822 | 2146 | 2098 | 2734 | 2058 | 2055 | 2283 | 2057 | 1795 | 1866 | 1906 | 451 | 329 |
| 2080 | 1831 | 1994 | | 1968 | 2465 | 1927 | 2117 | 2170 | 2575 | 2015 | 2270 | 2287 | 1985 | 1828 | 1990 | 1934 | 465 | 448 |
| 1893 | 1882 | 1859 | | 1878 | 1862 | 1854 | 1935 | 1888 | 2037 | 1598 | 1633 | 1762 | 1528 | 1652 | 1617 | 1599 | 471 | 255 |
| 2053 | 1569 | 2097 | | 1774 | 1524 | 1524 | 174 | 07 | 174 | 174 | 174 | 174 | 1631 | 1499 | 1563 | 1564 | 363 | 198 |
| 2383 | 2159 | 2097 | | 2213 | 1987 | 2275 | 2158 | 2143 | 2588 | 2169 | 1792 | 2159 | 1878 | 2066 | 1987 | 1977 | 609 | 447 |
| 2086 | 1827 | 1801 | | 2040 | 2048 | 1867 | 1897 | 2085 | 2403 | 1850 | 1809 | 2259 | 1739 | 1713 | 1745 | 1911 | 306 | 296 |
| 23.5% | 32.2% | 34.9% | | 1783 | 29.5% | 34.2% | 30.3% | 1800 | 44.8% | 31.5% | 41.3% | 1818 | 30.4% | 33.1% | 26.9% | 1576 | 185.8% | 100.0% |
| | | | | 1895 | | | | | | | | | | | | 1642 | | |

Recording

- Every number
- Every average
- % Non-uniformity of:
 - Oxide layer
 - Polish rate
- Average of Outer Ring
- Average of Inner Ring



Analyzing

- Polish Rate

$$= \frac{\text{initial thickness} - \text{final thickness}}{\text{Number of minutes}}$$

- % Non-Uniformity

$$= 100 \times \frac{\text{Max} - \text{Min}}{\text{Average}}$$

- In case of flyers:

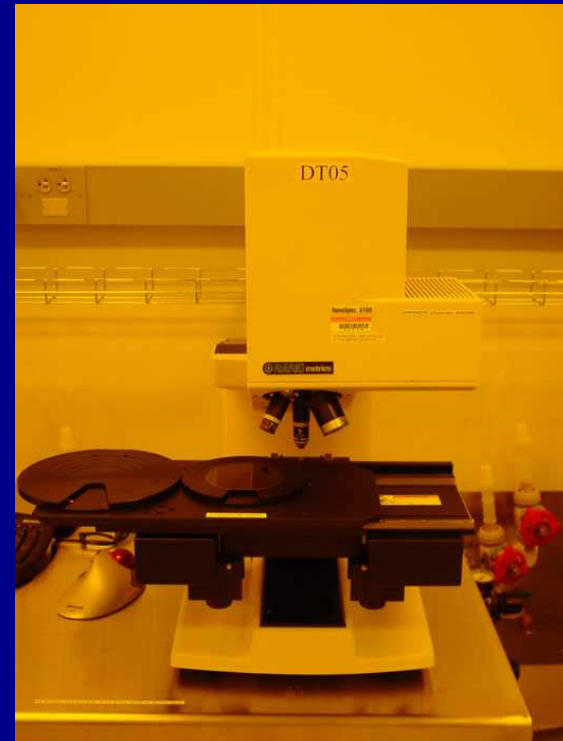
- Re-measure in case of mistake
- Do not use data

The Process



Recipe:

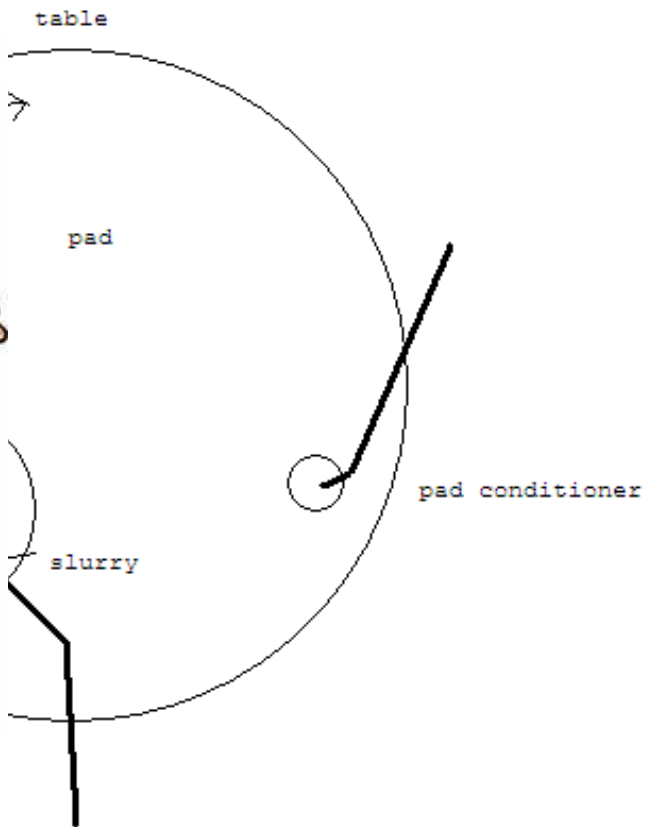
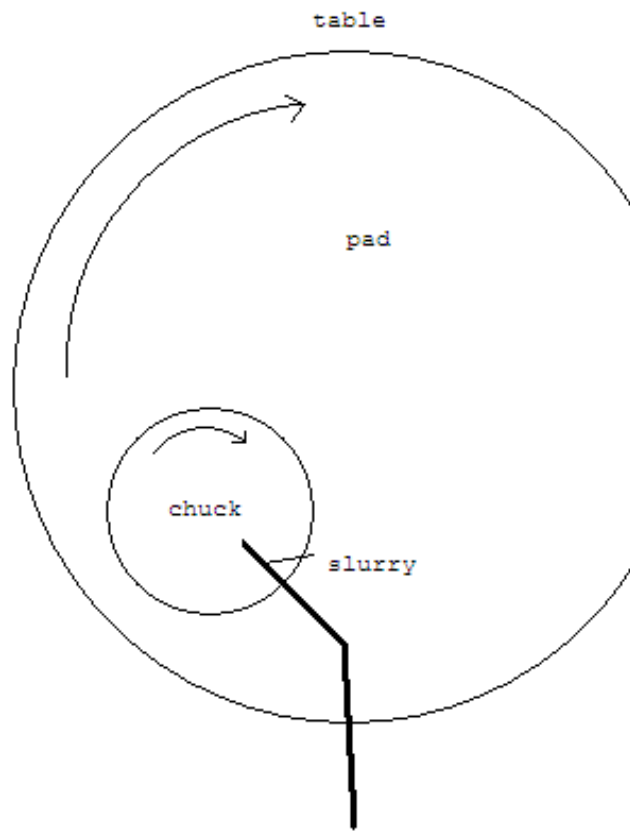
A-PE-USG-1.0



The Used Pad

Ex-situ

In-situ



The New Pad



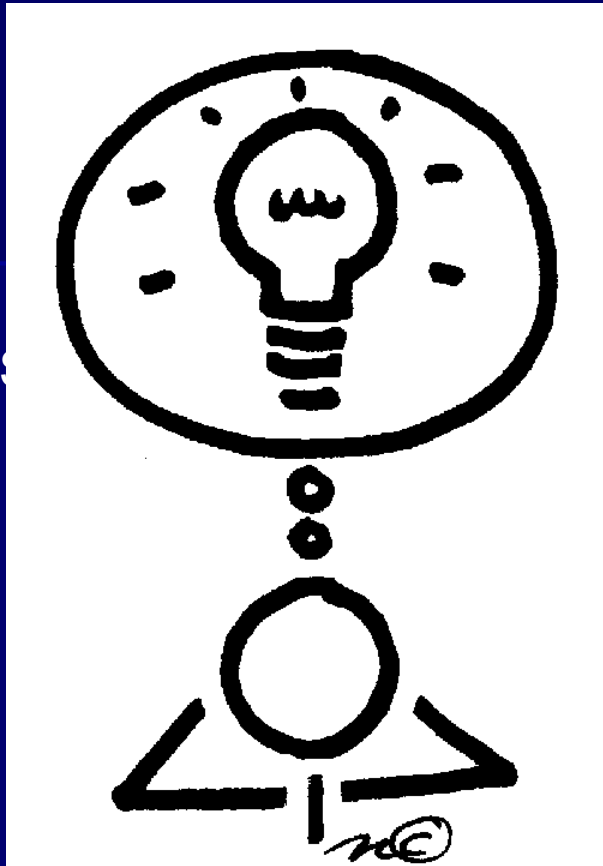


Table 5 Back Pressure Slurry Flow

run no.

1
2
3
4
5
6
7
8
9

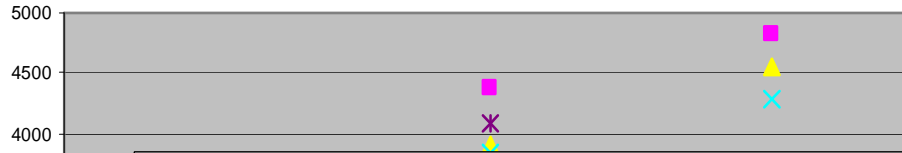
1=
2=
3=

| | |
|-----|----|
| 3 | 2 |
| 3 | 3 |
| 100 | 8 |
| 66 | 10 |
| 33 | 12 |

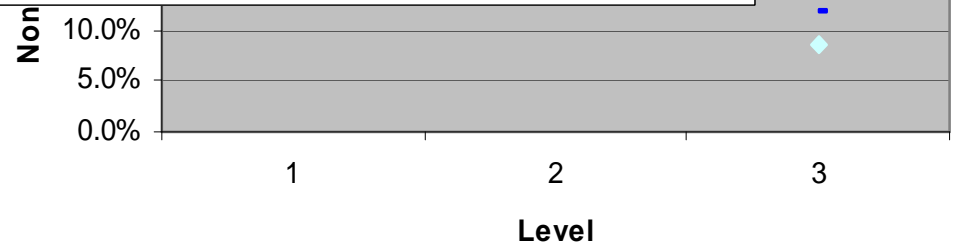
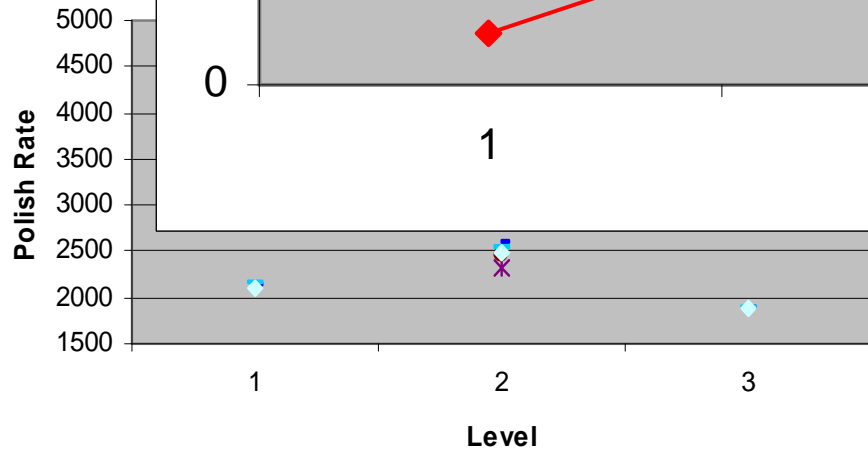
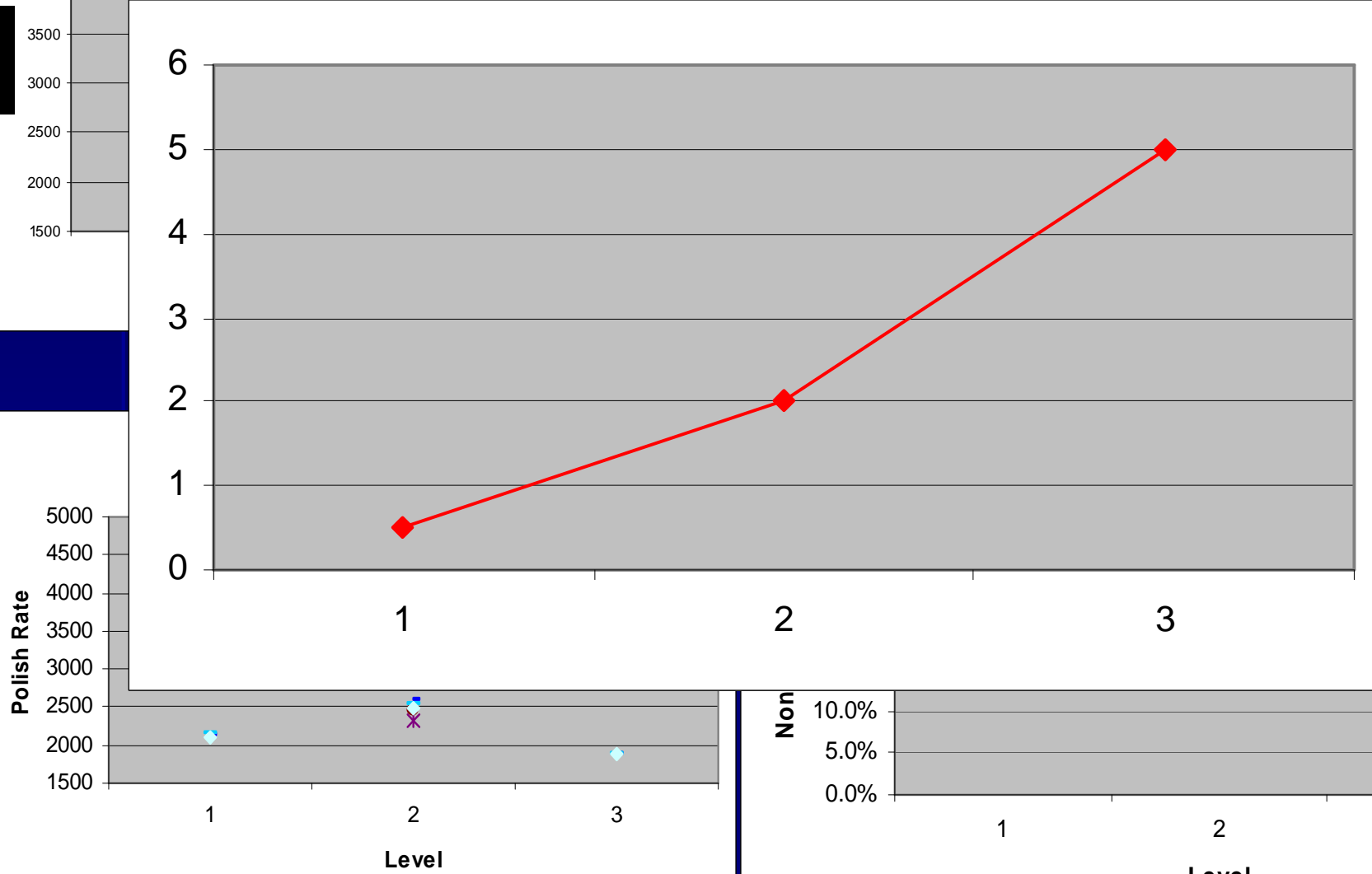
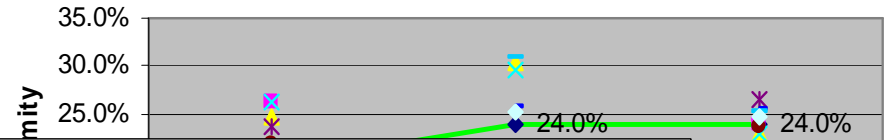
1
2
3
2
3
1
3
1
2
6

1
2
3
3
1
2
2
3
1
75
100
150

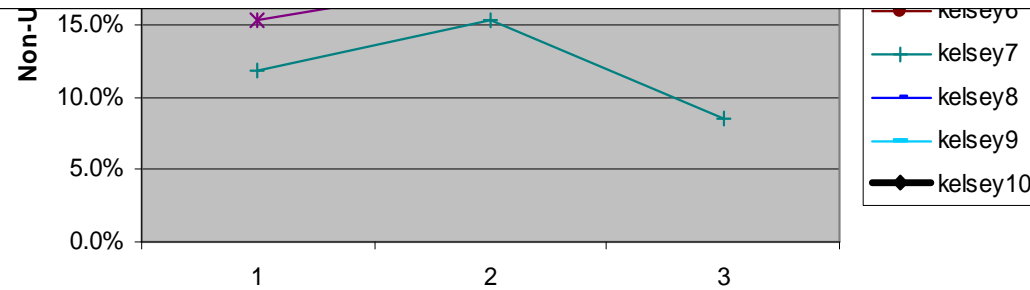
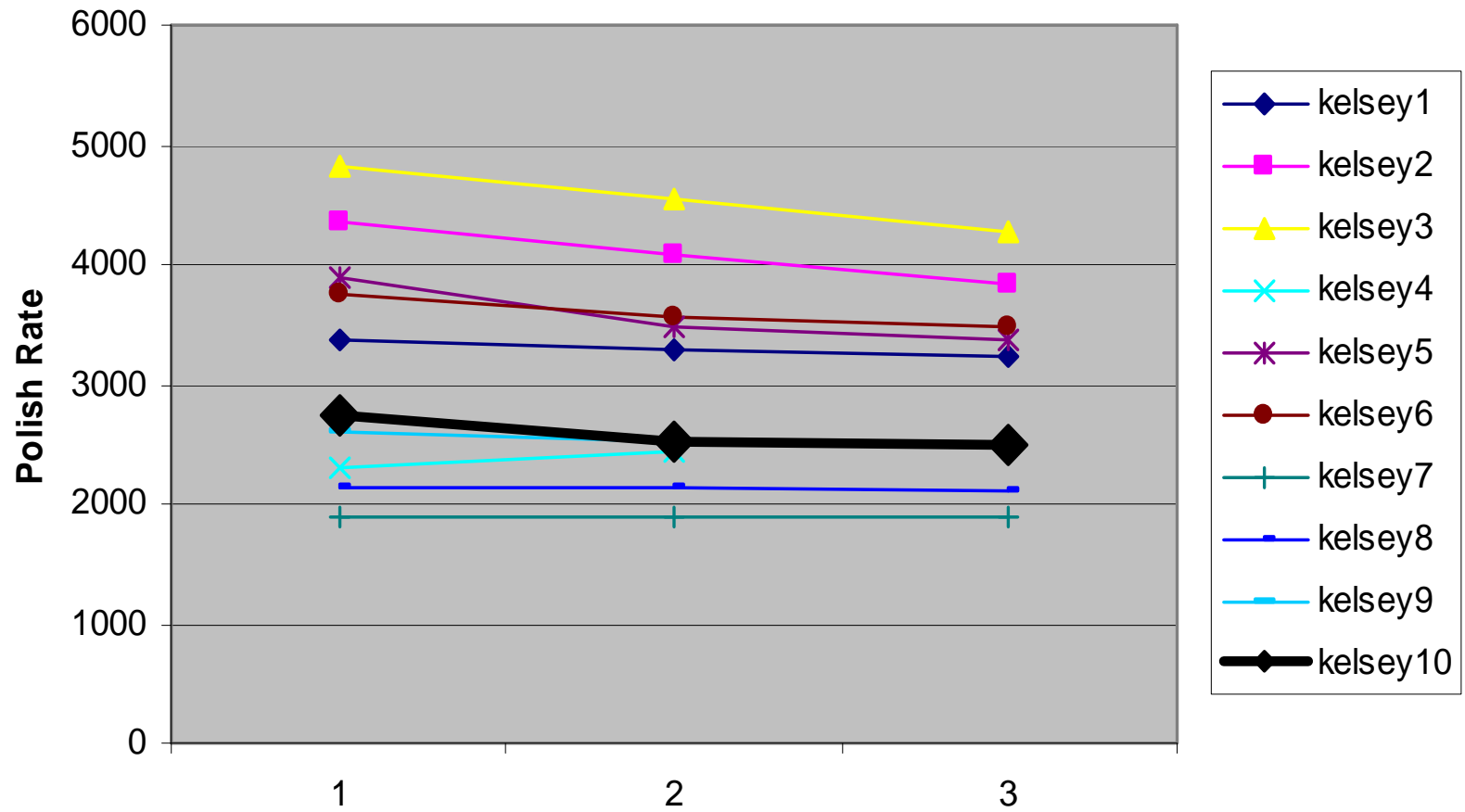
Down Force



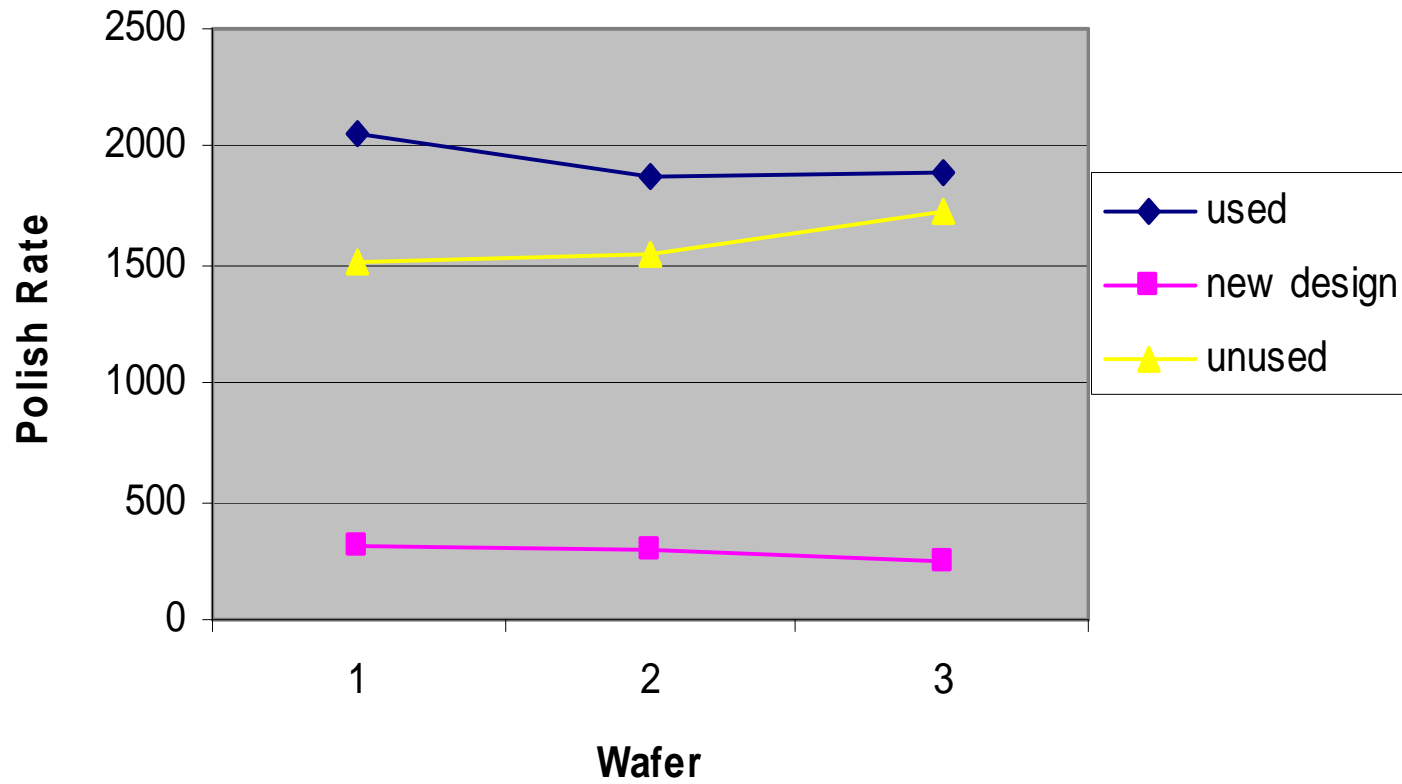
Down Force



Runs



Comparison of Pads



A Final Conclusion

- Don't throw away an old pad
- Keep your settings
- Try new things, it's not the end of the world if they don't work

Or Two



Acknowledgements

- Katalin
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