HSQ Contrast

- XR-1541 Resist
- spun at 5000RPM for 60sec
- developed with 3 conditions
  - 2.3% TMAH for 70sec
  - 25% TMAH for 7sec
  - 25% TMAH for 70sec

Definition of contrast

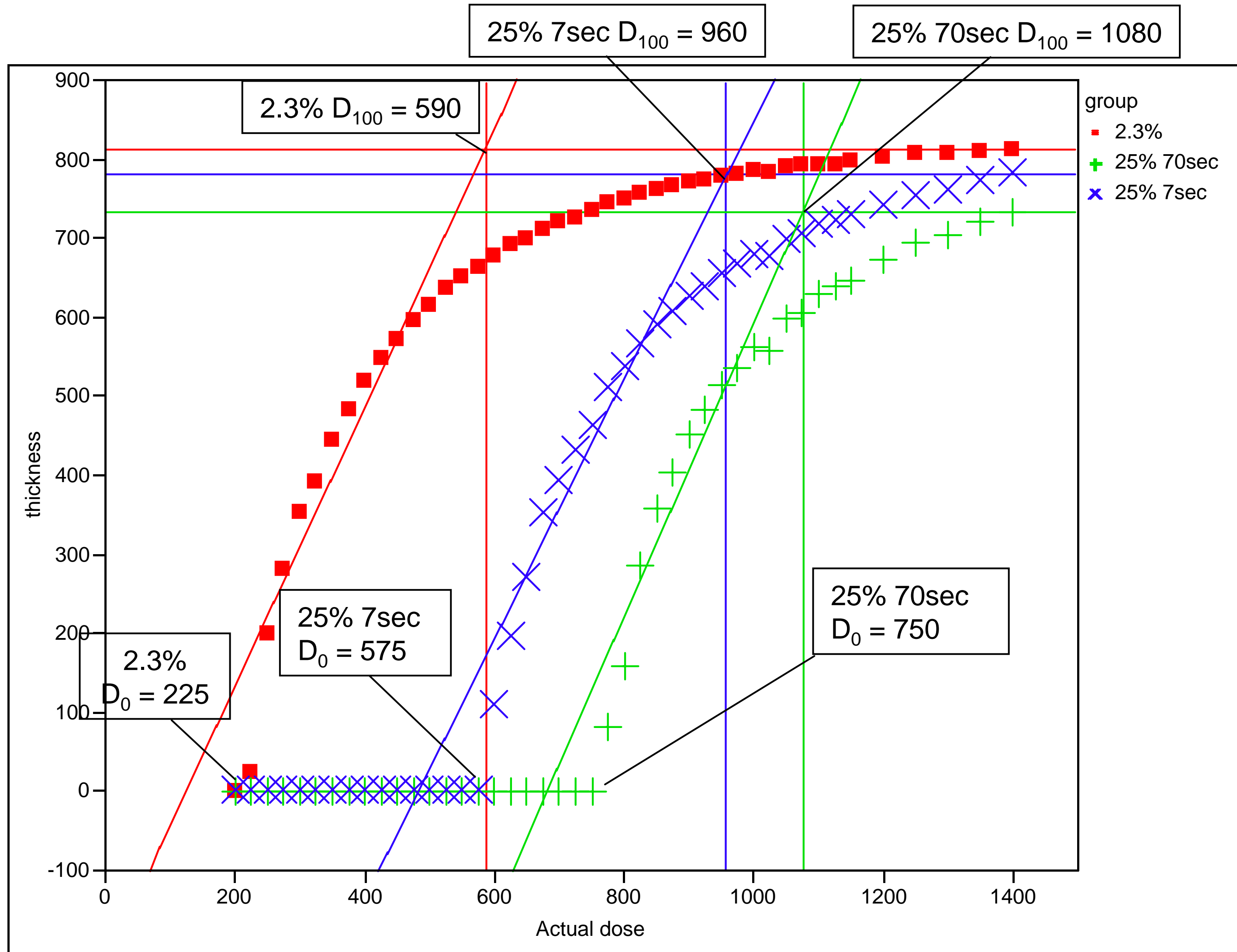
$$\gamma = \frac{d \ln r}{d \ln E} \qquad (1)$$

where r is the dissolution rate from an exposure dose, E.

$$\gamma = \frac{1}{\log\left(\frac{D_{100}}{D_0}\right)} \qquad (2), (3)$$

where D_{100} is the dose where all the positive resist is removed, and D_0 is the dose at which the positive resist begins to be removed. Dose is plotted on a log scale, and the resist is normalized from 1.0 to 0.

(1), Liddle, et.al., “Resist requirements and Limitations for Nanoscale Electron-Beam Patterning.
(2), Campbell, *The Science and Engineering of Microelectronic Fabrication*
(3), SPIE Handbook, Volume 1: Microlithography, Section 2.7



Linear Fit group=="2.3%"

thickness = -228.0989 + 1.7701099 Actual dose

Summary of Fit

RSquare	0.89926
RSquare Adj	0.890102
Root Mean Square Error	60.24733
Mean of Response	435.6923
Observations (or Sum Wgts)	13

Linear Fit group=="25% 70sec"

thickness = -1281.891 + 1.8683636 Actual dose

Summary of Fit

RSquare	0.897377
RSquare Adj	0.885974
Root Mean Square Error	55.22201
Mean of Response	399.6364
Observations (or Sum Wgts)	11

Linear Fit group=="25% 7sec"

thickness = -795.6264 + 1.6386813 Actual dose

Summary of Fit

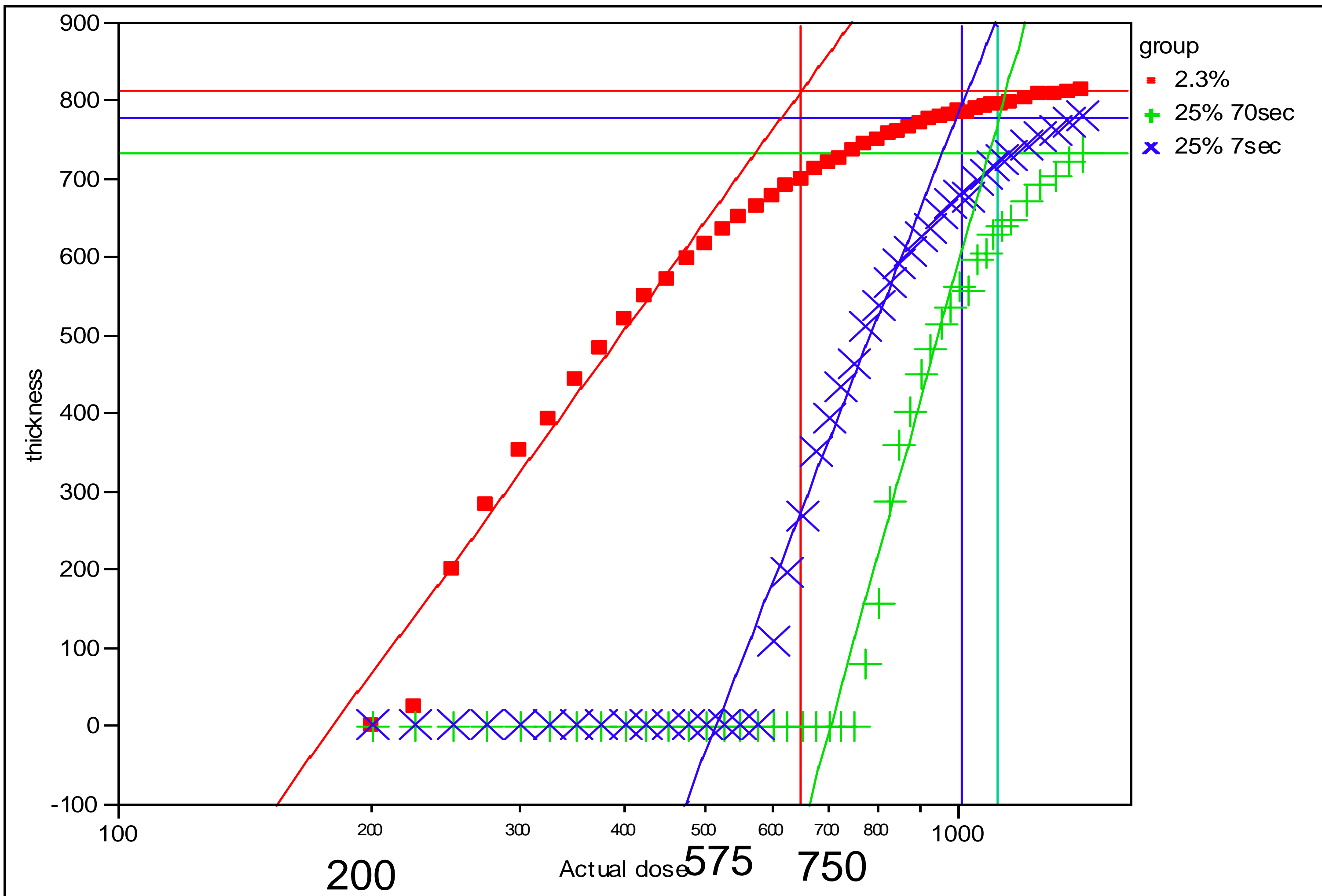
RSquare	0.941803
RSquare Adj	0.936512
Root Mean Square Error	41.4234
Mean of Response	433.3846
Observations (or Sum Wgts)	13

$$m_{2.3\%} = 1.8$$

$$m_{25\%_7\sec} = 1.9$$

$$m_{25\%_70\sec} = 1.6$$

650 1020 1120

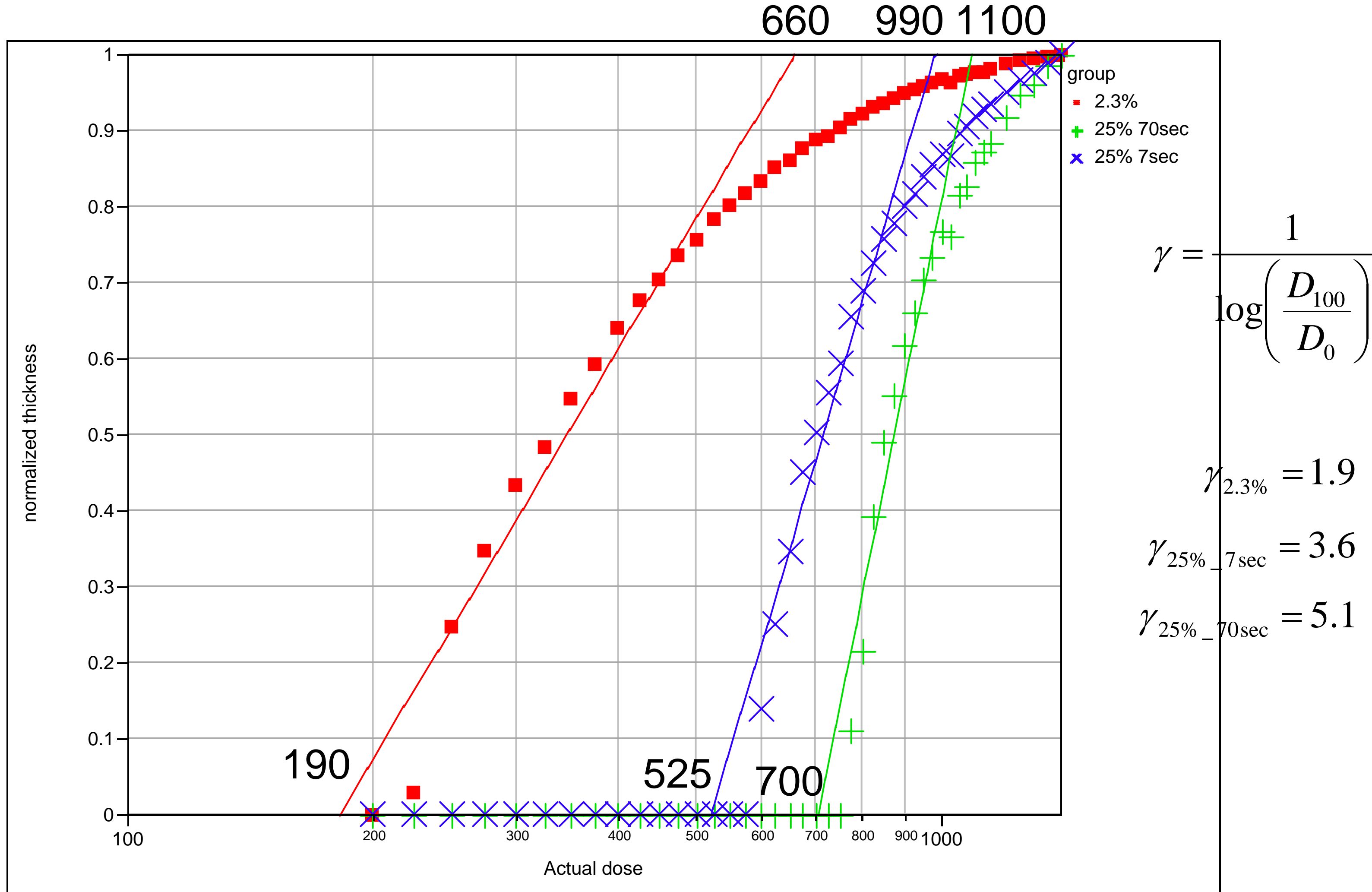


$$\gamma = \frac{1}{\log\left(\frac{D_{100}}{D_0}\right)}$$

$$\gamma_{2.3\%} = 1.95$$

$$\gamma_{25\%_7\,\text{sec}} = 4.0$$

$$\gamma_{25\%_70\,\text{sec}} = 5.7$$


660
990 1100
190
525
700
normalized thickness
Actual dose
group
2.3%
25% 70sec
25% 7sec
$\gamma = \frac{1}{\log\left(\frac{D_{100}}{D_0}\right)}$
$\gamma_{2.3\%} = 1.9$
$\gamma_{25\%_7sec} = 3.6$
$\gamma_{25\%_70sec} = 5.1$