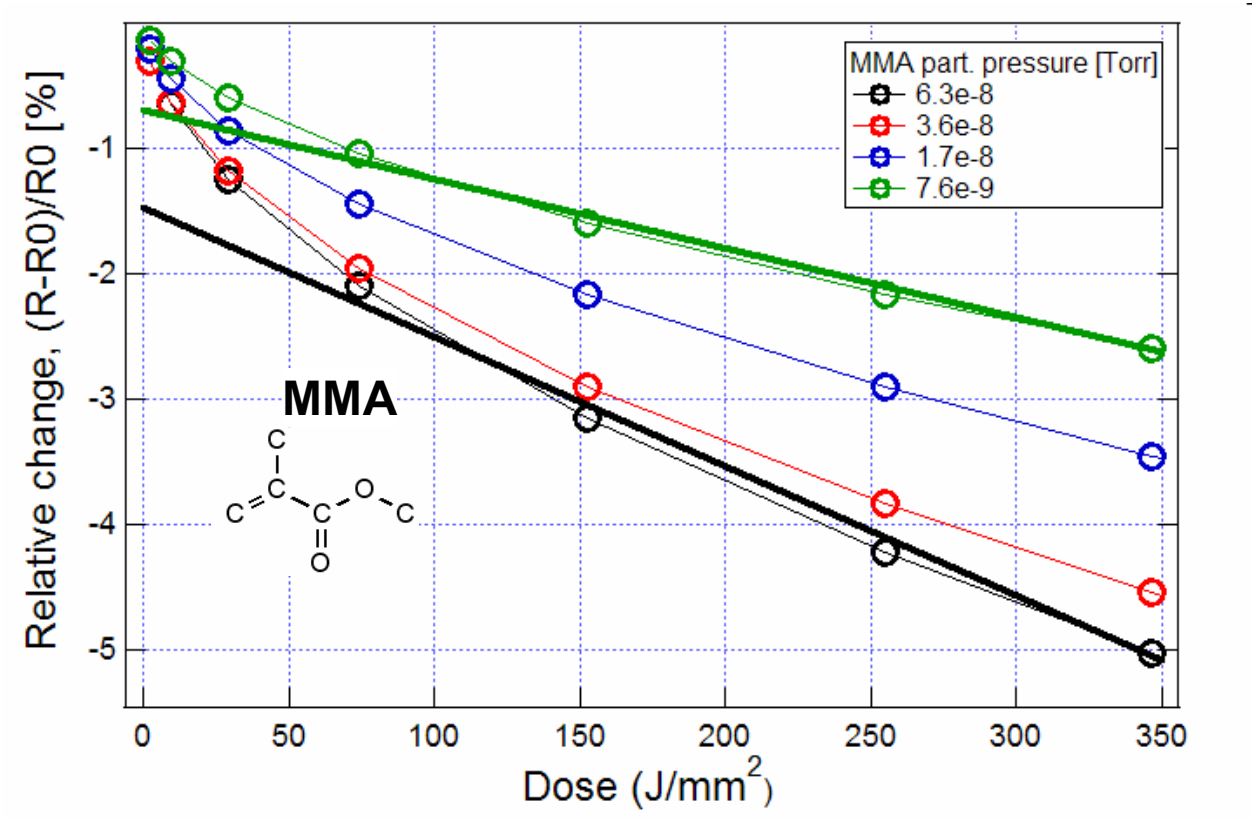
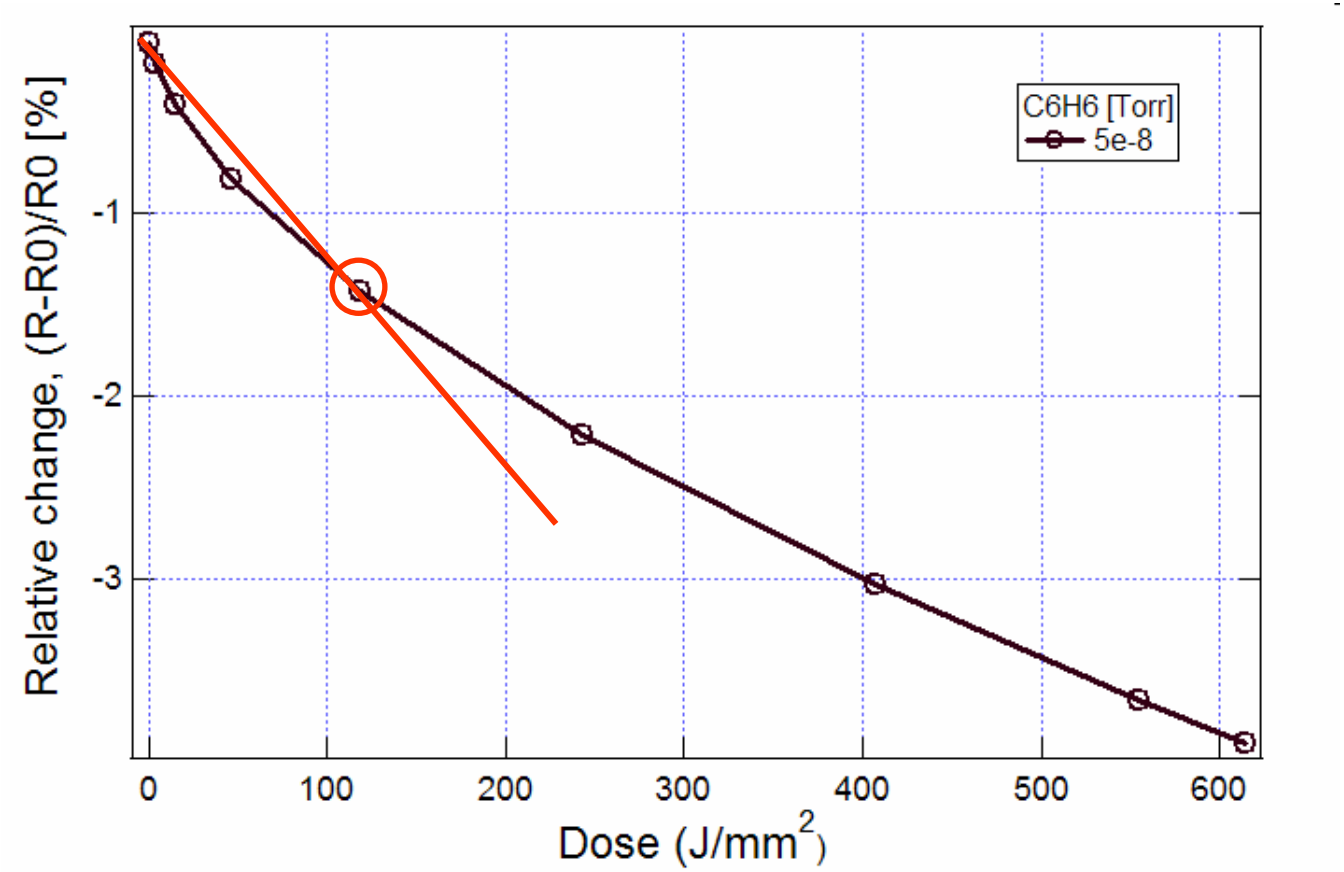
Damage not linear with dose over entire range



- Damage rate appears to be different for low and high doses
- Damage linear with dose in high-dose regime
- Low-dose data points from wings of Gaussian damage profiles have larger relative uncertainty
- Can not directly extrapolate high-dose data to get low-dose rates

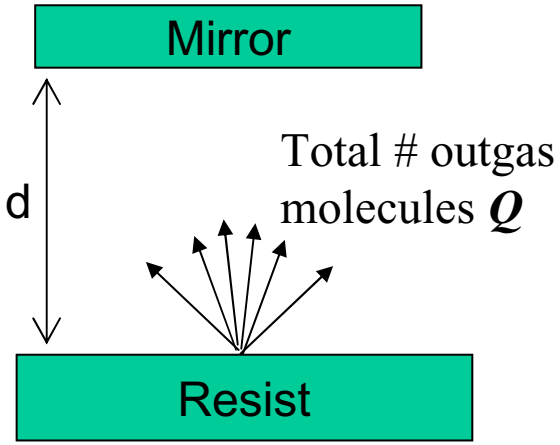
Benzene damage rate also appears different for low and high doses



- Use low dose point at 119 J/mm^2 (corresponds to intensity of ~2 mW/mm^2)
- *Lower bound* of damage rate in 5e-8 Torr benzene: 0.012 % / (J/mm^2)

Estimate fluence of molecules at mirror

- For C_6H_6 pressure of 5×10^{-8} Torr, impingement rate $Z = 1\times10^{13}$ molec/s/cm2
- During exposure time of 17 hrs, fluence of molecules striking surface from admitted gass: $F_{ad}=Z*(17*3600) = 7\times10^{17}$ molec/cm^2
- How does this compare to total fluence of molecules from resist outgassing?



As upper limit, consider all molecules emitted uniformly from point into 45° cone. Fluence of molecules at mirror is $F_{OG} \cong \frac{Q}{\pi d^2}$

- For max outgas case of 2.5 DTC full wafer: $Q=(8\times10^{14}$ molec/cm$^2)*(660$ cm$^2)= 5\times10^{17}$ molec.
- With d=10 cm: $F_{OG}= 3\times10^{14}$ molec/cm^2 < 1ML!
- So F_{ad}~2000*F_{OG}

Estimate loss expected from outgas of single wafer

- Define the relative loss in reflectivity following exposure to EUV intensity I and gas fluence F as

$$\rho \equiv \frac{\Delta R}{R_0} \propto I \cdot F$$

- Then the loss due to outgassing of a single wafer can be related to loss measured for admitted gas exposures, ρ_{ad}, by

$$\rho_{OG} = \rho_{ad} \frac{I_{OG}}{I_{ad}} \frac{F_{OG}}{F_{ad}}$$

- Assuming completely linear scaling of benzene data

$$\rho_{OG} = \rho_{ad} \frac{I_{OG}}{I_{ad}} \frac{F_{OG}}{F_{ad}} = (1.43) \frac{2\ mW/cm^2}{200\ mW/cm^2} \left(\frac{1}{2000} \right) = 7 \times 10^{-6}\ \%$$

- Not surprising that no resist has failed the ρ=2% criterion