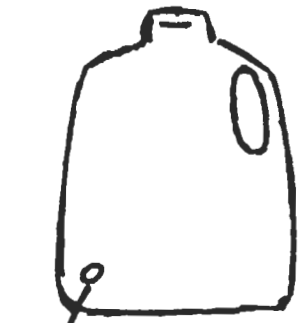
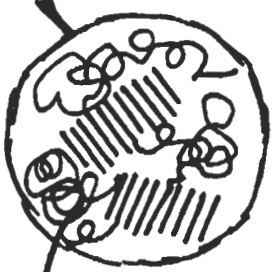
The Polymeric Solid State

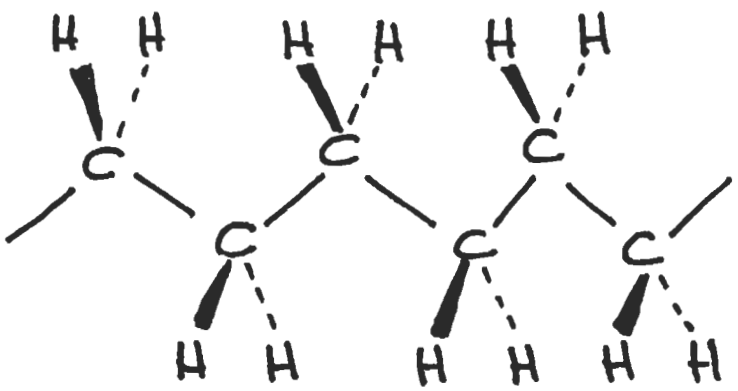


Blow-molded HDPE milk bottle (recyclable)



Semicrystalline microstructure

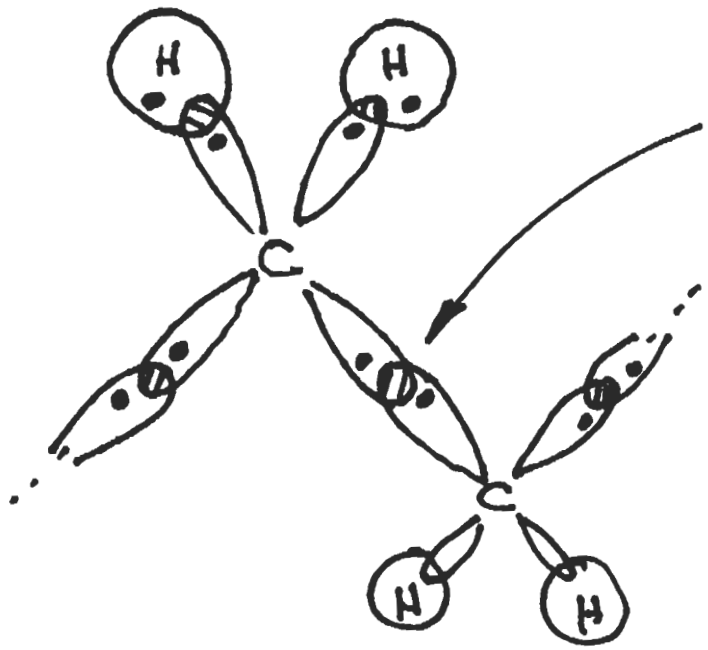
Long-chain molecule



Covalently-bonded hydrocarbon

Bonding

- Single $2s^2 2p^2 \rightarrow sp_3^4$



σ bond

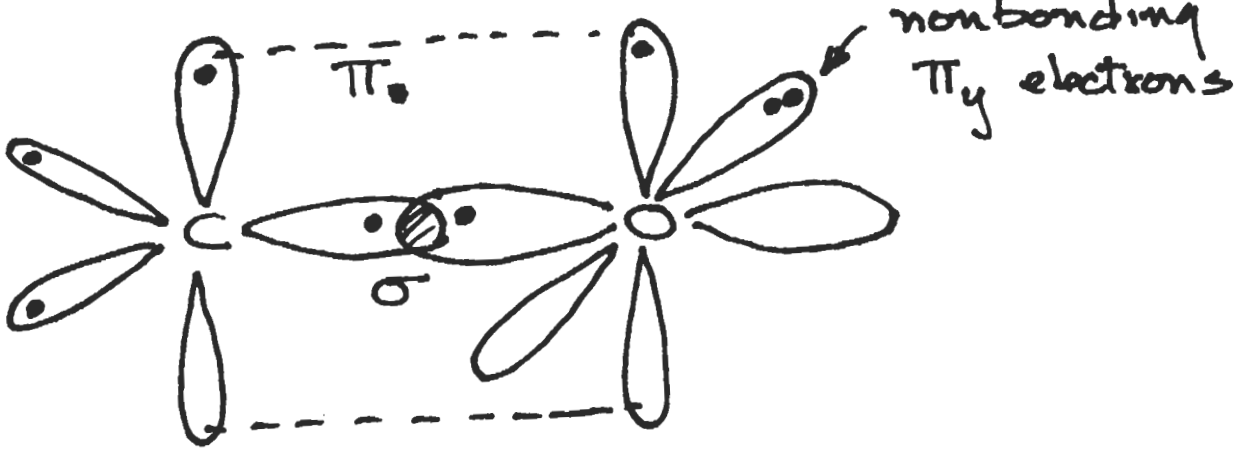
$l = 154$ pm

$E_d = 346$ kJ/mol

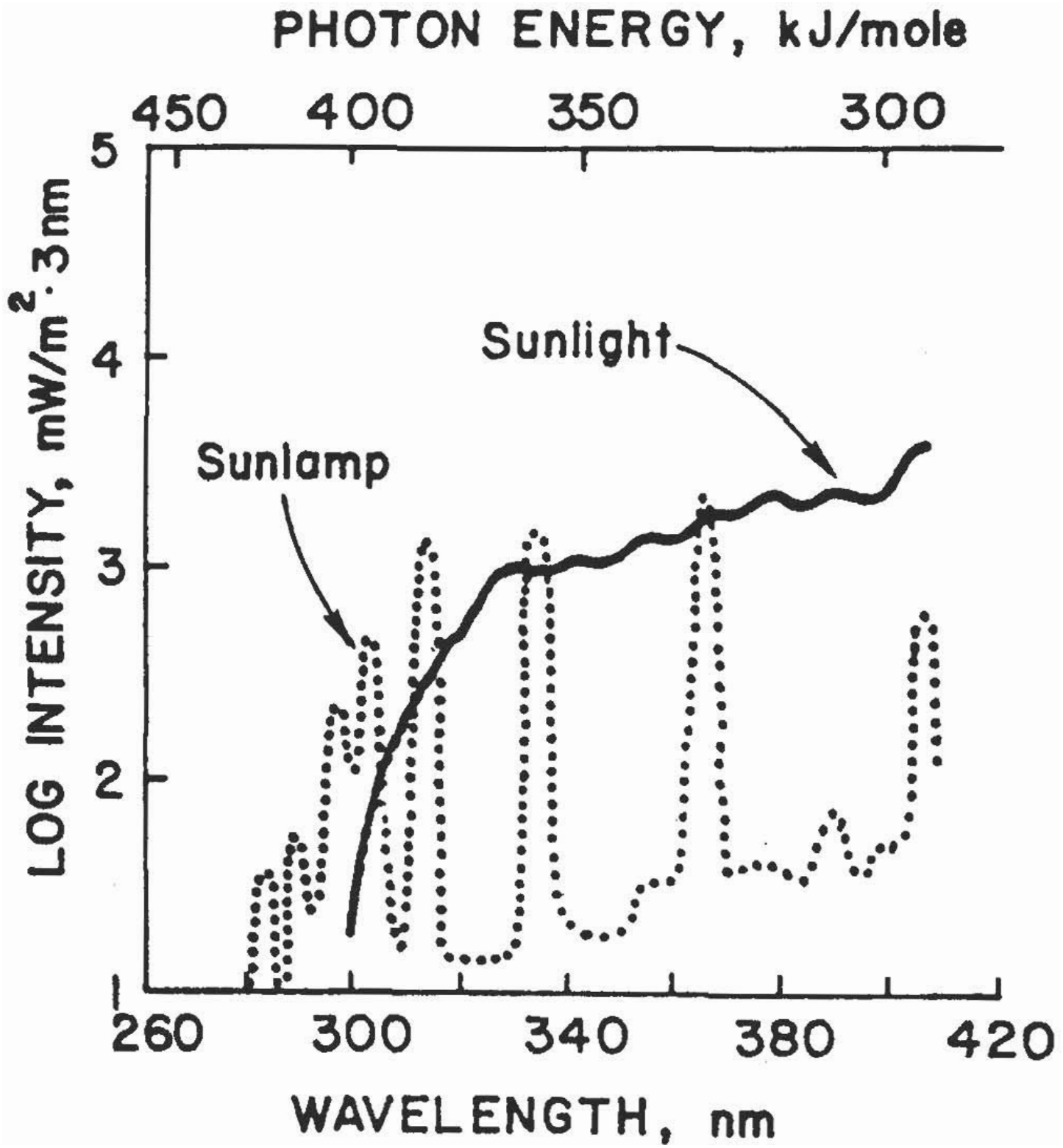
easy rotation

- Double eg carbonyl $\backslash C{=}O /$

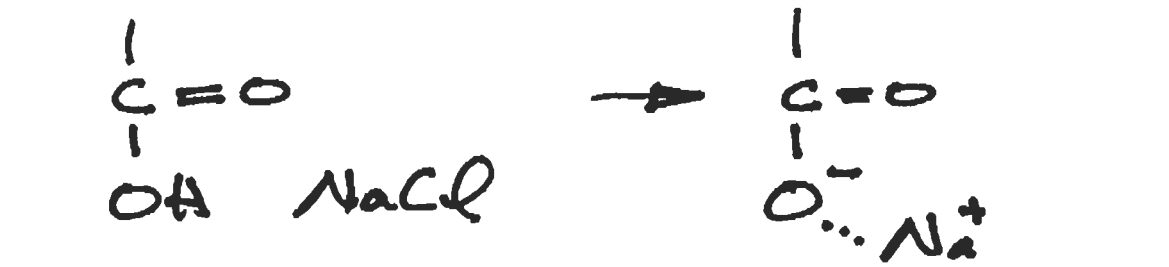
C: $2s^2 2p^2 \rightarrow sp_2^3 2p_z^1$ O: $2s^2 2p^4$

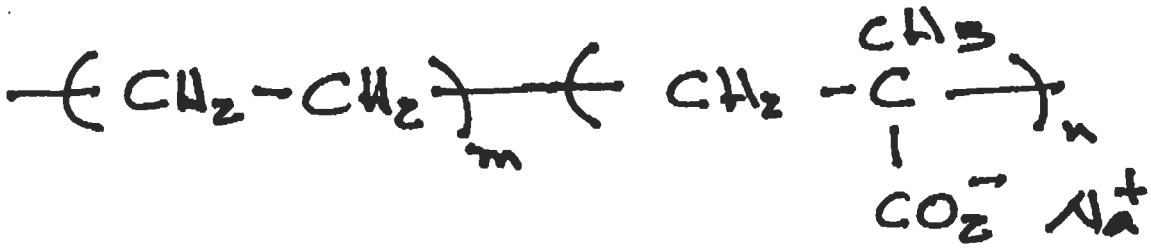


$\Delta E_{n \rightarrow \pi^*} = 400$ kJ/mol, $\lambda = \frac{hc}{\Delta E} = 300$ nm


PHOTON ENERGY, kJ/mole
450
400
350
300
5
4
3
2
1
LOG INTENSITY, mW/m^2·3nm
Sunlight
Sunlamp
260
300
340
380
420
WAVELENGTH, nm

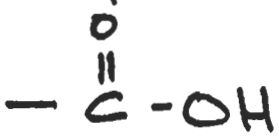
- Ionic - eg Surlyn™ ionomer



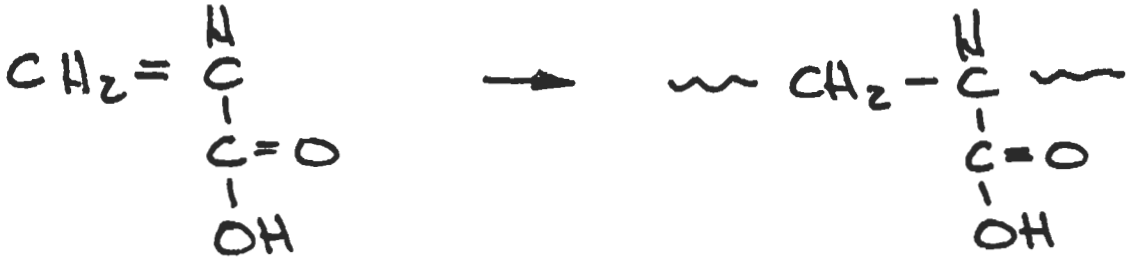


Nomenclature - an example

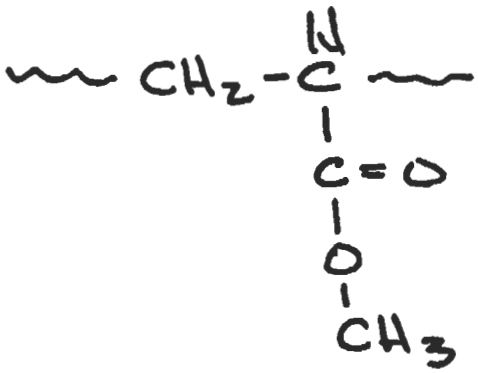
- carboxylic acid



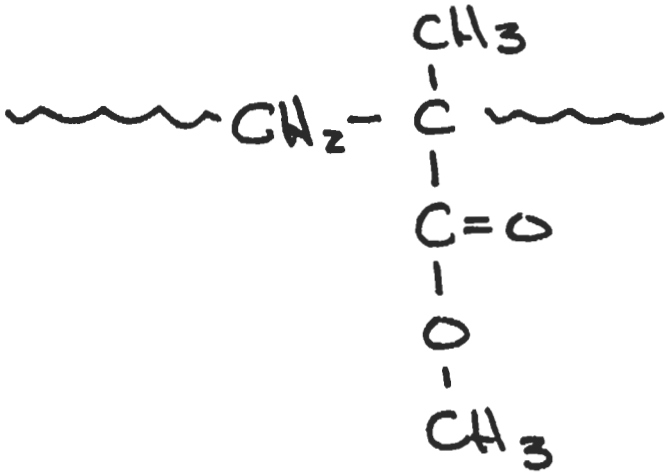
- acrylic acid → polyacrylic acid



- polymethacrylate



- polymethyl-methacrylate (PMMA)



Some Dominant Characteristics

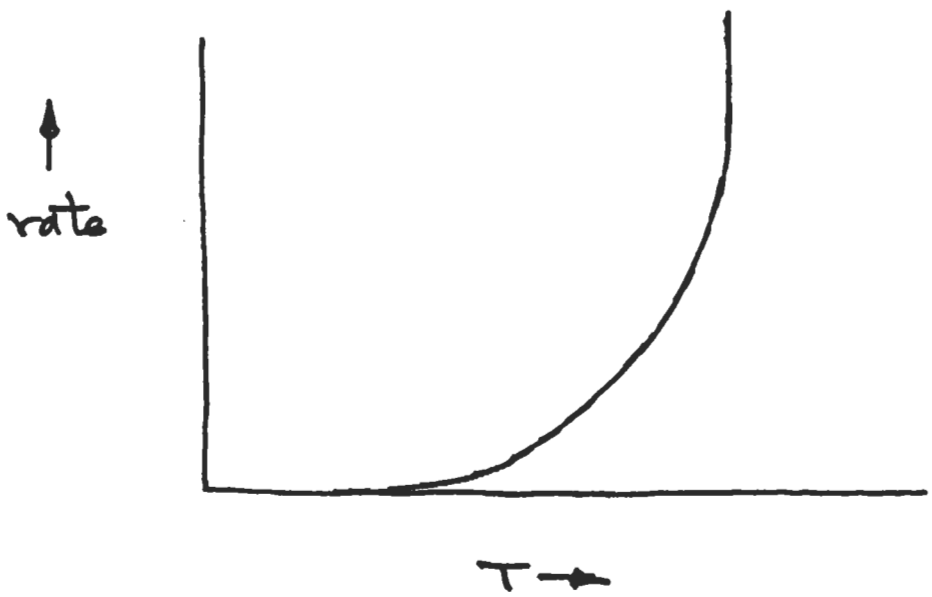
- Anisotropy of bonding

primary, appx. 100 kcal/mole

secondary, appx 1 kcal/mole

- Conformational change

$\text{rate} \propto \exp \frac{-E}{RT}$



- Network junctions