

Styrene copolymers

□ SAN

- copolymers of S + AN
- better PS
 - mechanical (tougher), thermal (higher T_g), chemical (polar)
- transparent housewares, parts, ---

□ ABS

- impact modified SAN
- interpolymer from copolym'n of (S + AN) with PBD
 - SAN matrix + PB domain + PB-g-SAN
- opaque housings, parts, ---
- special grades
 - fire-resistant, clear, high T, ----

E-MAA copolymer

Ch 4 Sl 20

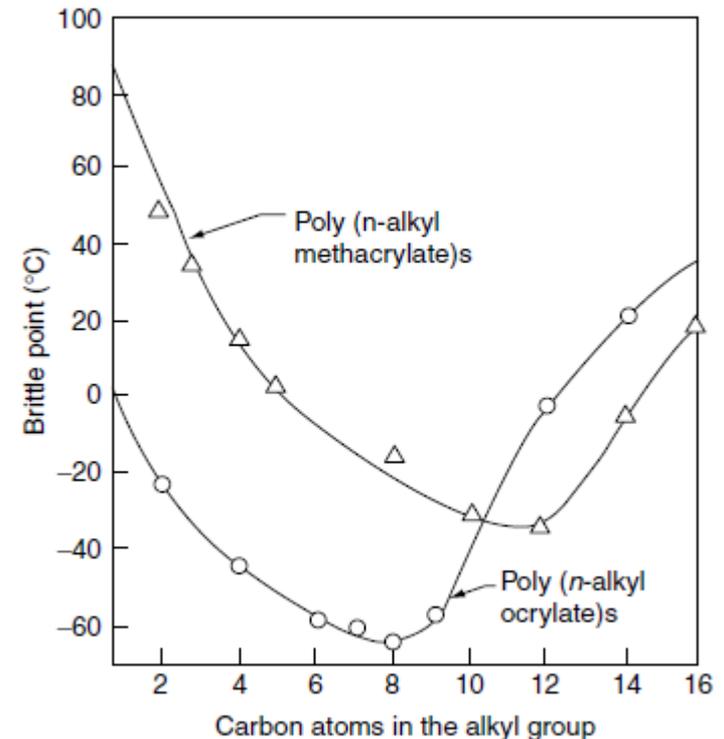
- an ionomer
- Surlyn®
- transparent, resilient, barrier
- laminating, cut-proof, food packaging, ---

Acrylic polymers

- derivatives of poly(meth)acrylic acid
- PAN
 - semicrystalline, high T_m , hard to process
 - sol'n polym'n - direct spinning ~ 'acryl fiber' (wool)
 - dyable by copolym'n
 - SAN, ABS, nitrile rubber
- polyacrylates
 - low T_g ~ adhesives, sizing, coating
 - peroxide vulcanization ~ 'acryl rubber'
 - copolym'n with E ~ comparable to EVA

□ polymethacrylates

- higher T_g than PA's
- PMMA ~ 'acryl resin'
 - largest volume acrylics
 - transparency, weatherability
 - toughness,
 - window, lighting, ---
- higher PMA's
 - lower T_g with larger subs
 - finishes
- PHEMA
 - copolymer w/ EGDMA
 - network ~ hydrogel ~ soft lenses



- polyacryl amide
 - water-soluble and H-bonding
 - modified to cationic or anionic ~ flocculants
 - copolymerize with $-\text{NH}_4\text{Cl}$ or $-\text{COOH}$
 - water thickener ~ flooding aid in oil well
 - lightly Xlinked ~ hydrogel ~ water superabsorbent
- poly(meth)acrylic acid
 - lightly Xlinked ~ hydrogel ~ water superabsorbent
- acryl adhesives
 - polycyanoacrylates ~ (anionic) polym'n with water ~ 'super glue'
 - TMGDMA ~ Xlinking ~ glue for metal

Vinyl polymers

□ PVAc

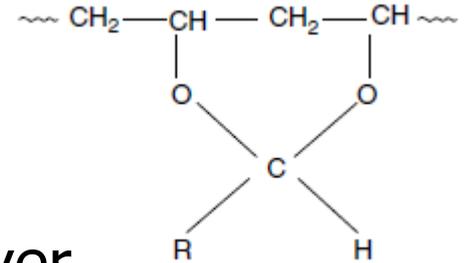
- $T_g \approx RT \sim$ used as latex \sim paint, sizing
- EVA \sim copolymer'n with E
 - lower X_c , higher flexibility, stability, ---
 - cover range from LDPE to plasticized PVC, rubber

□ PVA

- prepared by hydrolysis of PVAc
- property dep on MW and DOH
 - low DOH \sim water soluble packaging
 - high DOH \sim high X_c , H-bonds \sim high strength, water insoluble
 - wet-spun \sim fiber \sim Vinalon, Vinyon

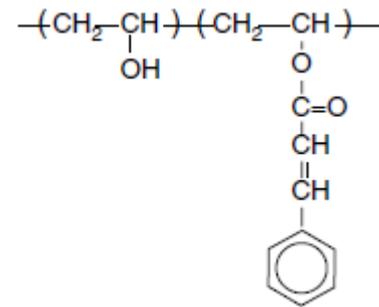
□ polyvinyl acetals

- from PVA or PVAc
- R=H ~ polyvinyl formal ~ adhesive
- R=C3 ~ polyvinyl butyral ~ glass interlayer



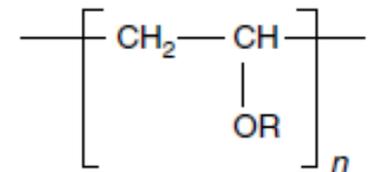
□ polyvinyl cinnamate

- from PVA or PVAc
- can be photo-Xlinked ~ photoresist



□ polyvinyl ethers

- R=Me ~ adhesive
- R=Et or iBu ~ pressure sensitive adhesive



- PVP
 - water and oil soluble
 - loose addition to skin
 - cosmetics, blood plasma substitute
- polyvinyl carbazole
 - high T_g , photoconductive
 - xerography

Condensation polymers

- formed by reaction of functional group
- contains heteroatoms

- polyesters
- polyamides
- formaldehyde resins
- PU
- oxide, sulfide, ---

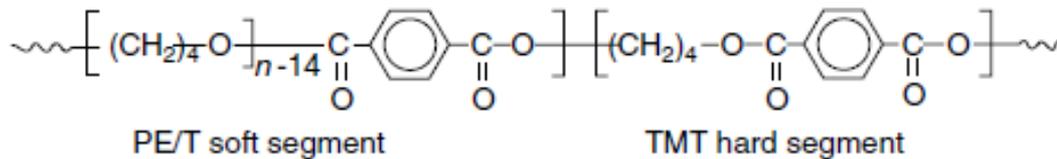
- polyester, polyamide, (m)PPO, PC, polyacetal ~ 5 EPs

Polyesters

- PET
 - esterification or ester exchange
 - fiber (apparel, tire cord) ~ drawn ~ higher MW, X_c
 - film, bottle
- PBT
 - lower T_m , T_g
 - engineering applications
- PCT
 - higher T_m , T_g
 - engineering applications
- PEN, PTT [PPT]

□ polyester TPE

- block copolymer
- PET hard segment + PTMG soft segment



□ unsaturated polyesters

- polyester w/ double bond
 - diacid + diol + diacid w/ = p491
- Xlinked by addition polymer
- usually with reinforcement

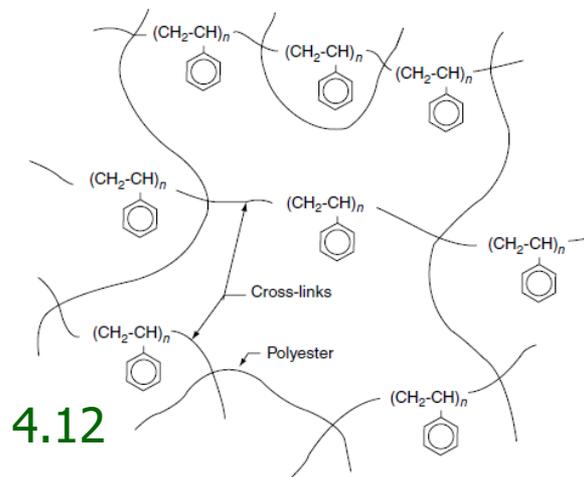
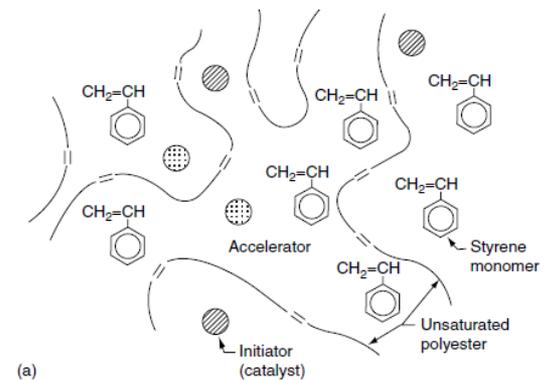
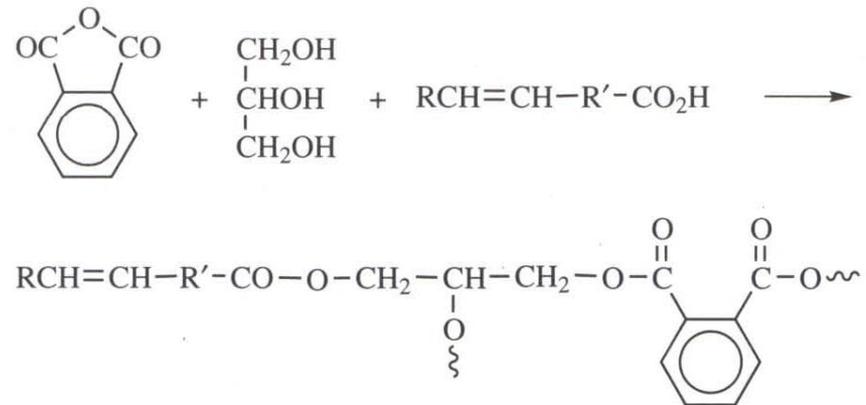


Fig 4.12

□ alkyd resin

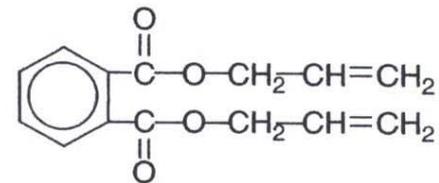
acid \rightarrow alkyd

- multifunctional alcohol + anhydride + fatty acid w/ =
- unsat'd polyester with terminal =
- laminating



□ allyl resin

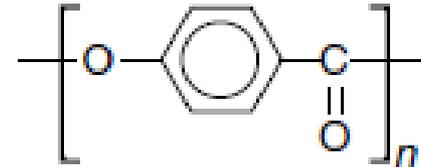
- allyl alcohol + diacid
- alone or w/ unsat'd polyesters



Aromatic polyesters

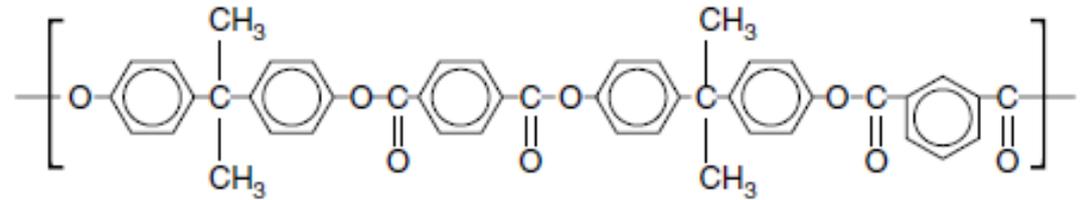
□ polybenzoate

- 'homopolymer'
- comparable to PTFE, UHMWPE
- parts



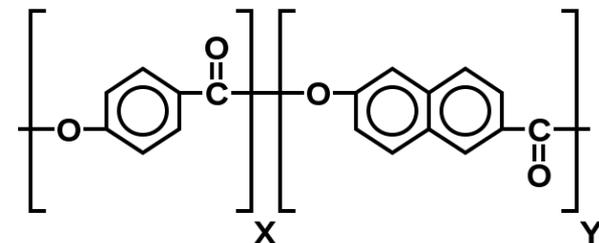
□ polyarylate

- BPA + TPA + IPA
- amorphous
- comparable to PC, PSF
- engineering applications



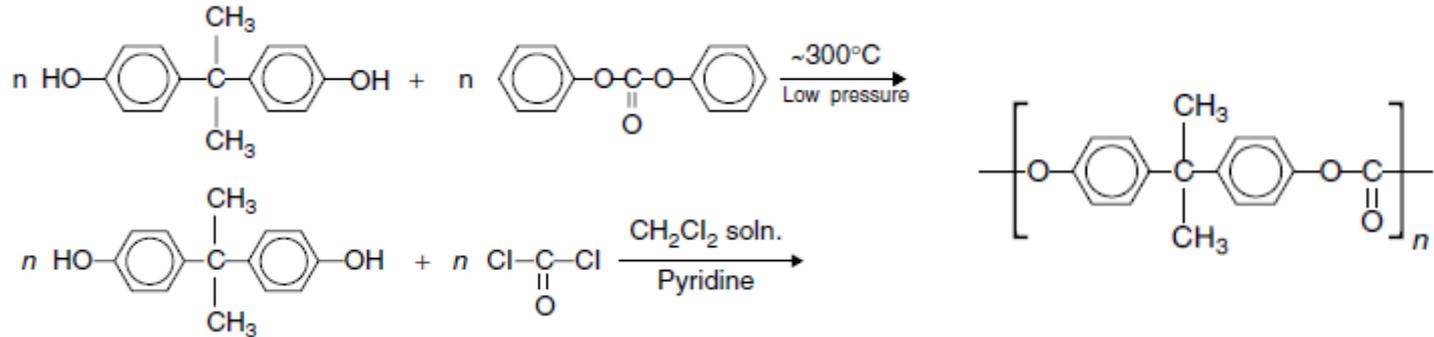
□ liquid crystalline polyester

- fully aromatic
- Vectra[®]



Polycarbonate

- melt (Bayer, Dow, Lotte) or interfacial (GE, LG)



- transparent, tough(est), heat-resistant
 - better PMMA
- engineering plastic
- weak hardness, weatherability, ESC
 - needs modification
 - blend with ABS, PBT

Polyamides [PA]

□ aliphatic polyamides \equiv nylon

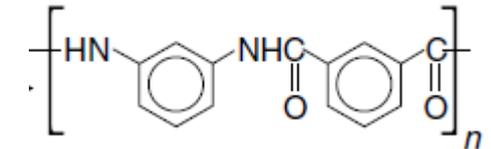
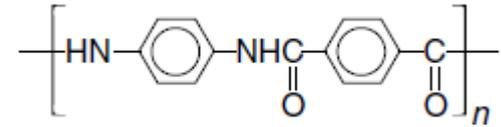
nylon 6 \equiv PA6

- nylon x \sim from amino acid or lactam
- nylon xy \sim diamine + diacid
- property dep on distance betw amide group
 - amide \sim stiff, H-bonding, polar
 - tough, high T_m , hygroscopic
 - chemical and abrasion resistant
- Commercial \sim 6, 66, 610, 612, 11, 12
- fiber (90%), resin (parts, film, ---)
- modification
 - blend with PPO, ---
 - polyamide-polyether TPE

□ aromatic polyamides

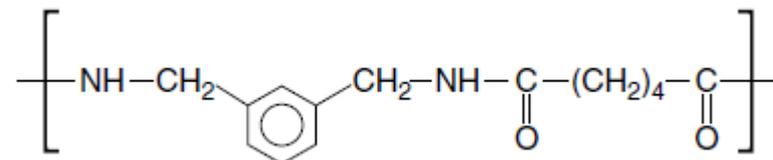
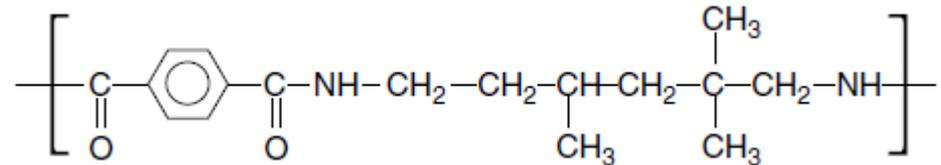
■ wholly aromatic ~ 'aramid'

- Kevlar and Nomex
- high strength, high T_m , hard to process
- fiber for FRP



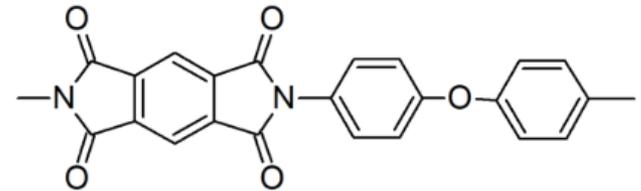
■ partially aromatic

- semicrystalline or amorphous, still high $T_m(T_g)$,
- processable



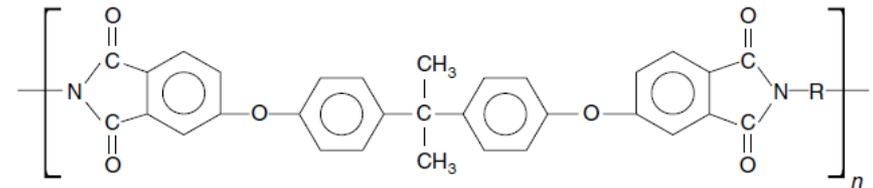
Polyimides [PI]

- 2-stage polym'n
 - polyamic acid, shape, then PI
 - Upjohn process ~ 1-stage



- highest heat resistance
 - high-temp film, coating, seal, foam, fiber

- tractable PI



- polyamideimide
- polybismaleimide ~ for composites
- polyesterimide
- polyetherimide [PEI] ~ BPA ~ super enpla