Copolymerization

AAA – A – A – AAA → Homopolymer

– $M_1 M_2 M_1 M_2 M_2 M_1 M_1 M_2 M_1 M_1$ – – – – Random

– $M_1 M_2 M_1 M_2 M_1 M_2$ – – – – – alternating

– $M_1 M_1 M_1 M_1 M_1 M_2 M_2 M_2 M_1 M_2$ – – block

– $M_1 M_1 M_1 M_1 M_1 M_1 M_1 M_1 M_1 M_1$ – graft copolymer
(M_2 branches)

Reactivity ratios of each monomer decide the copolymerization type

M_1 → reactivity ratio → M_2 / M_1

$r_2 = 0.02$

→ alternating

$r_1 = 0$ (at 60°)

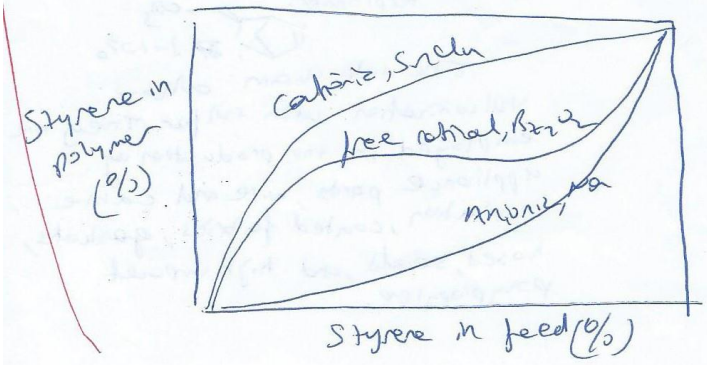
Addition polymerization

– free radical

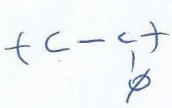
– cationic $\quad -C=C- \xrightarrow{+} -C-C^{\oplus}$ $\xrightarrow{C=C}$ $-C-C-C^{\oplus}$

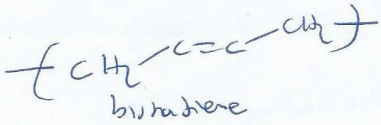
– anionic $\quad C=C \xrightarrow{B:} B-C=C:^{\ominus}$ $\xrightarrow{C=C}$ $-C-C-C:^{\ominus}$

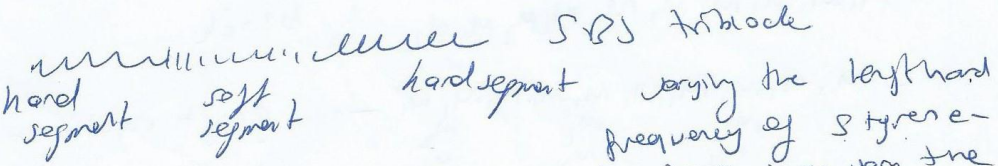
Styrene – methylmethacrylate ⇒ copolymer



Commercial copolymers (main examples are Elastomers)

 crystalline, rigid, high tensile, hard surface, unreactive

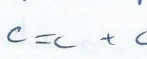
 Amorph, rubbery, low tensile, high extension, soft reactive



SBS triblock

varying the length/ frequency of Styrene-butadiene, you vary the properties.

Ethylene-propylene copolymer → two commercially available types present



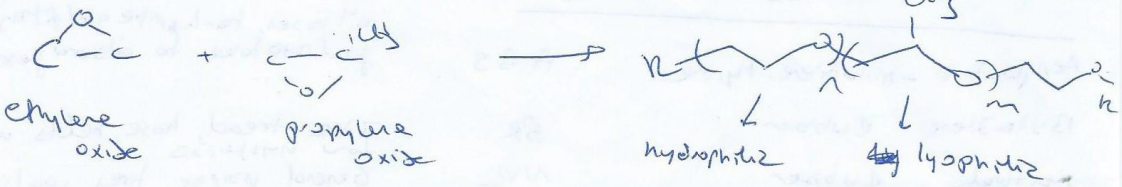
- EPM → saturated and require vulcanization if used as a rubber. They are used in a variety of automotive applications, including as body and chassis parts, bumpers, radiator and heater hoses, seals, mats and weather strips.

"good resistance to ozone, heat, oxygen) they are used in automotive panel blends (with nylon for example)

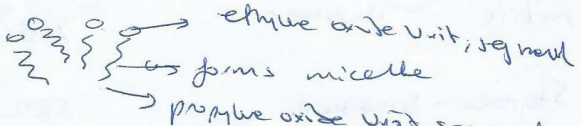
EPDM → ethylene-propylene-diene terpolymer.

 3-15%

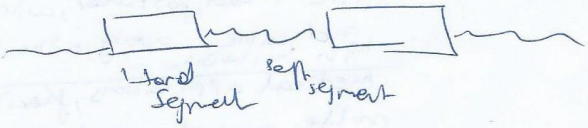
The side chain allow vulcanization with sulfur. They are employed in the production of appliance parts, wire and cable insulation, coated fabrics, gaskets, hoses, seals, and high impact polypropylene.



Pluronics (surfactant)

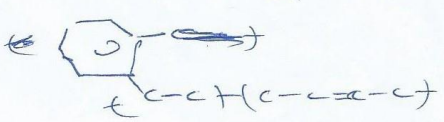


pharmaceutical application



(the same in Lycra polyurethane – PEG)

like in Velcro



hard segment that readily crystallizes forming a physical crosslink.

Elastomers

Elastomers typically contain chemical and/or physical cross-link. while there are thermoplastic elastomers such as Styrene-Butadiene-Styrene (SBS) and block copolymers, most elastomers are Thermosets.

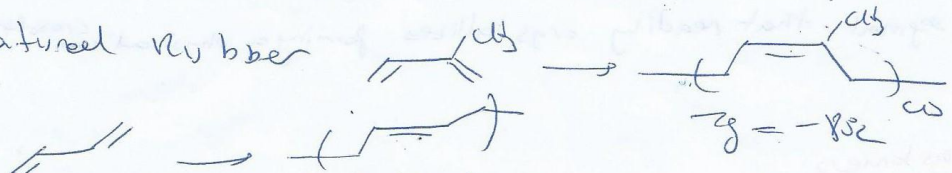
Elastomers are characterized by a disorganized (high entropy) structure in the resting or nonstressed state. Application of stress is accompanied by a ready distortion requiring (relative to plastic and fibers) little stress to effect distortion.

while entropy is the primary driving force for elastomers to return to the original resting state, the cross link allow the material to return to its original shape giving the materials a type of memory.

Common elastomers and their uses

Acrylonitrile – butadiene – Styrene	ABS	oil hoses, tank, pipe and fittings, good resistance to oils and gases
Butadiene Rubber	BR	Tire tread, hose, belts. very low hysteresis.
Natural Rubber	NR	General purpose tires, seals, footwear.
Nitrile Rubber	NBR	Seals, automotive parts that are in contact with oils and gases.
Styrene – Butadiene	SBR	Tire tread, footwear, wire and cable covering, adhesives. high hysteresis.
Silicones		medical applications, flexible molds, gaskets, seals, extreme use temperature range

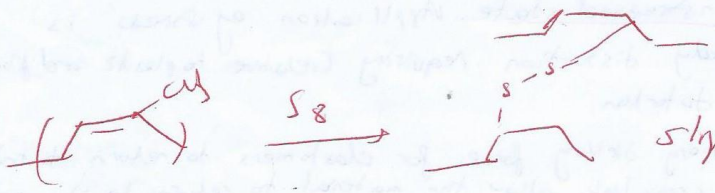
Natural Rubber



Sentetik kauçuklar
Tg = −18°C

12 Kasım 1942 Sibirya −20°C 100,000 kanyen Tg
nin altına düşmüş ve cam gibi kırılmış.

Şimdi anyonik polimerizasyon ile cis butadiene elde edilebiliyor



A rubber typically low hysteresis (measure of energy absorbed when the elastomer is deformed)
→ x-linked rubber to enhance hysteresis

(3)

Rubbers typically have low hysteresis.

Hysteresis → measure of energy absorbed when the elastomer is deformed.

A rubber that absorb a great amount of energy as it is deformed (such as a tire hitting ~~bumps~~ bumps on the roadway) is said to have a high hysteresis

low hysteresis & high resilience (or vice versa)

~~If~~ Tires with high hysteresis are often prefered in drag-race tires where heat build up (allows better grip of the tracks.

↳ like SB (styrene-butadiene)

butadiene number → low hysteresis

Thermoplastic elastomers, can also be ~~mainly~~ achieved through physical mixing of hard and soft segments.

polypropylene + ethylene propylene copolymer → blending in extruder

polypropylene + natural rubber → Dynamic vulcanizate (natural rubber mixed in the presence of polypropylene during extrusion x-linked)

-x linked materials

⇒ greater oil and solvent resistance.

⇒ reduces or eliminates the flow of this phase at high temperature and/or under high stress.

Recycling can be accomplished through the particalizing (grinding into small particles) of the elastomeric materials followed by a softening-up by application of a suitable liquid and/or heat and, finally addition of a binder that physically or chemically allows the particles to bind together in the desired shape.