

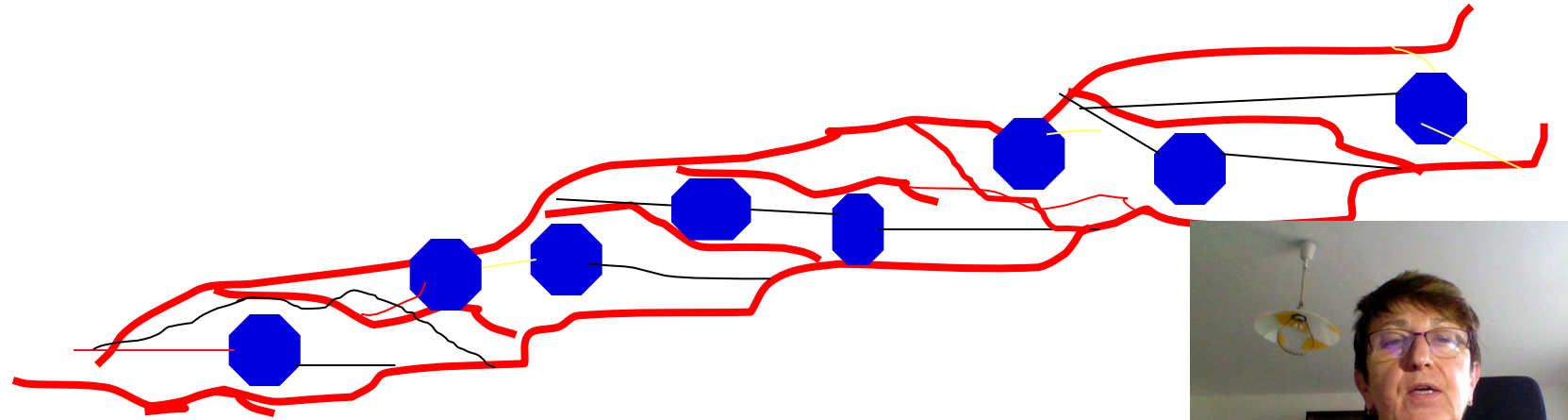
M U N I
M E D

Preclinical dentistry I.

Composite materials I.

Composite materials

Chemically bonded mixture of organic matrix and inorganic fillers



Coupling agent – binds organic matrix and the filler together



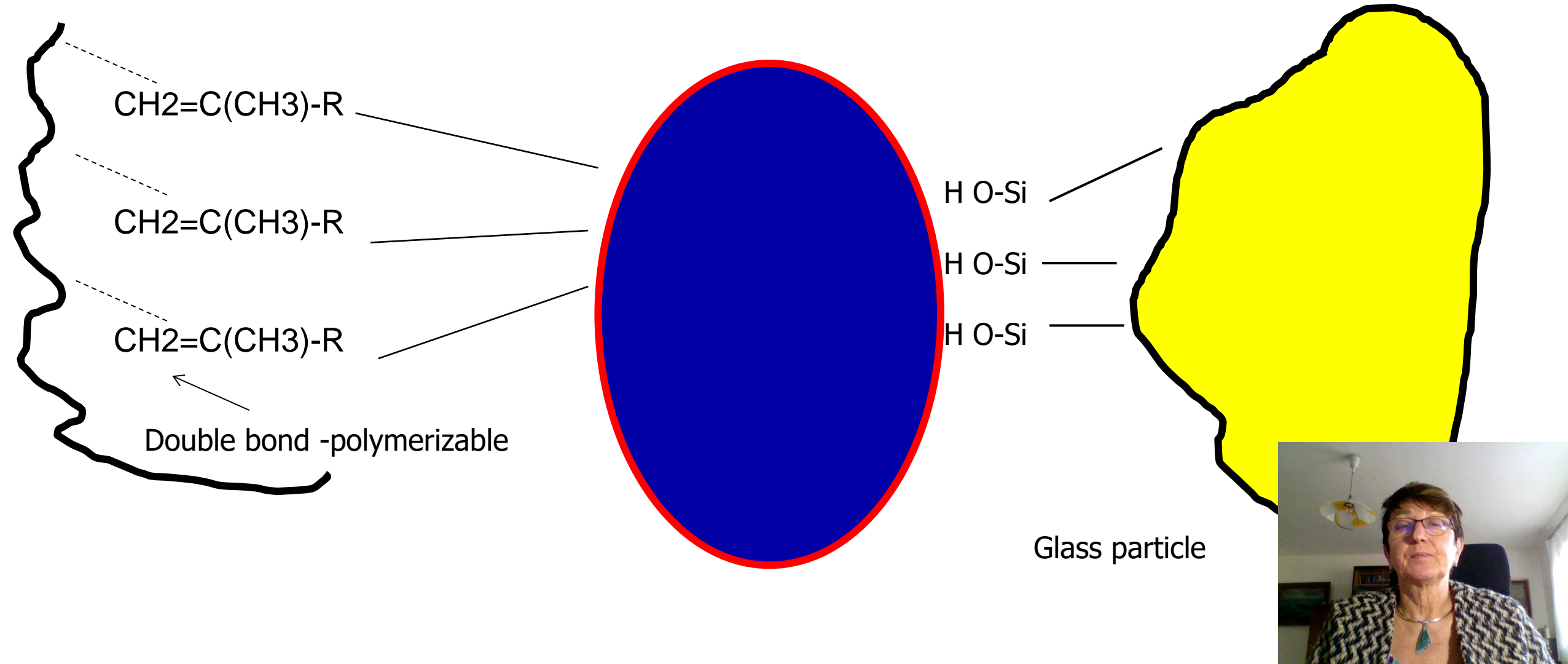
Homogenous distribution of the filler particles in the material



Excellent mechanical properties



Binding of the coupling agents to glass particles



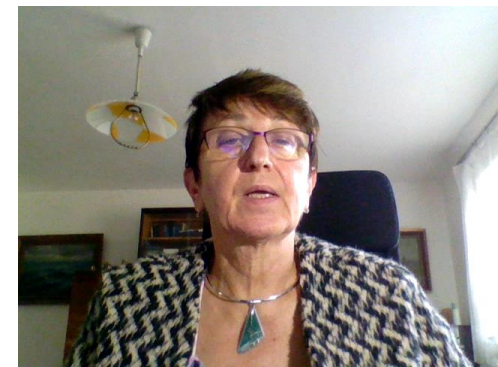
Filler – material

- Milled quartz
- Aluminium silicate glass
- Silicon dioxide
- Prepolymer (composite material is polymerized with high pressure in fabrics, than milled – particles of the filler are made of cured composite)
- Complexes of microfiller (agglomerates) – e-g-. silicon dioxide or zirconium oxide



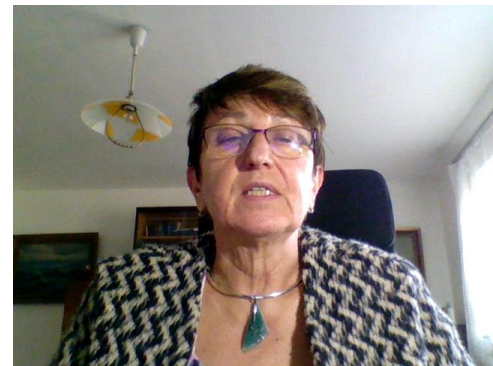
Filler acc to the size of particles

- Macrofiller (size of particles μm ot tenth of μm)
- Microfiller (hundredths od μm)
- Nanofiller (nm)
- Combination– hybrid
 - Conventional (μm)
 - Microhybrid (hundredths od μm , μm)
 - Nanohybrid (hundredths od μm , μm , nm)



Macrofiller

- Particles μm or tenths of μm
- Good mechanical resistance , abrasion resistance, bad polishability.

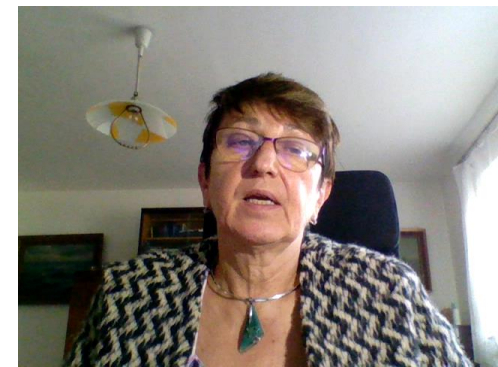


Microfiller

- Silicium dioxide (pyrogenous)
- Particles hundreths μm

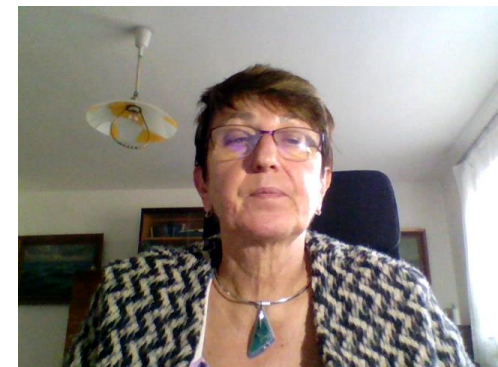
Less amount of filler due to big surface

Lower mechanical resistence, good polishability.



Microfiller in complex particles

- Prepolymer
- Agglomerates
 - Higher amount of filler, good mechanical resistance, good polishability



Nanoparticles

- Particles 10 nm and less

Special technology, size, shape and binding to monomer



Today

– Microhybrid or nanohybrid composites:

Good mechanical properties, good polishability, propagation of cracks is minimized.



Matrix

Bis GMA – Bowen's monomer • (2,2-bis[4-(2hydroxy-3-metakryloyloxypropoxy)

- fenyl]propan)

- UDMA Urethandimetacrylate

Other dimetacrylate

- *Dimethacrylates - mixture of materials with high and lower molecular weight*

Coupling agent

- G -methacryloxypropyltrimetoxysilan (A 174)



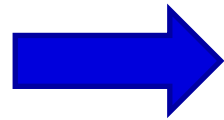
Other components

- Activator and initiator
- Pigments
- Fluorescents
- Absorbers of light
- Inhibitors



Selfcuring composites- two components material

– Tertiary amine Dibenzolyperoxide



– **Activator**

Initiator

Light curing composites

Initiator and sometimes also
activator

Camphorquinon CQ
Is the most common initiator in
light curing composites

Composite materials – basic characteristics

| | Matrix | | Filler |
|--------------------------|--------|---|--------|
| Compressive strength | | ↓ | ↑ |
| Elasticity | | ↑ | ↓ |
| Polymerization shrinkage | | ↑ | ↓ |
| Polymerization stress | | ↓ | ↑ |
| Water sorption | | ↓ | ↑ |



Classification of composite filling materials

- According to the size of the filler particles

Macrofilled, microfilled hybrid

- According to the mode of curing

Selfcuring, light curing, dual curing

- According to the viscosity

flowable, thick



Principle of retention

- Micromechanical retention

Microscopic spaces are created in enamel and dentine – composite material flows into them.

For the creation of the retentive pattern acid etching gel is used.



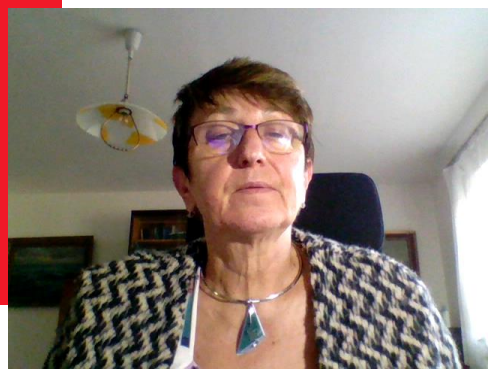
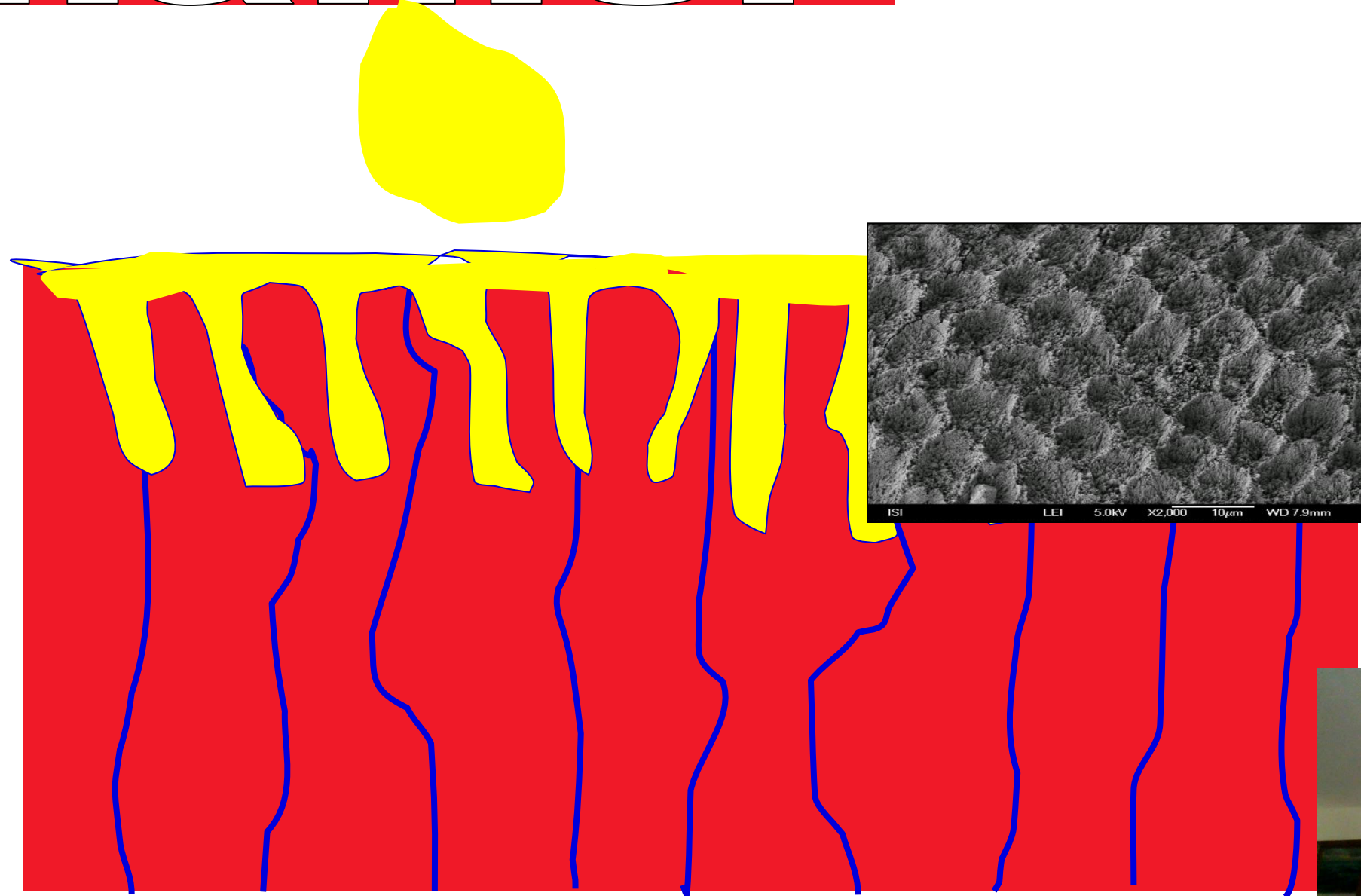
35% - 37% phosphoric acid

silica particles

blue dye



Enamel

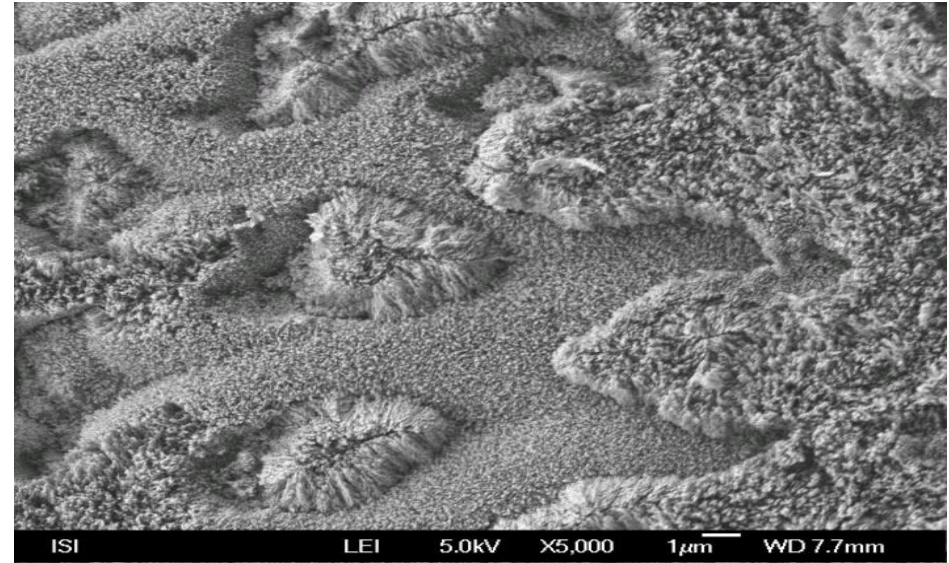


How it works?

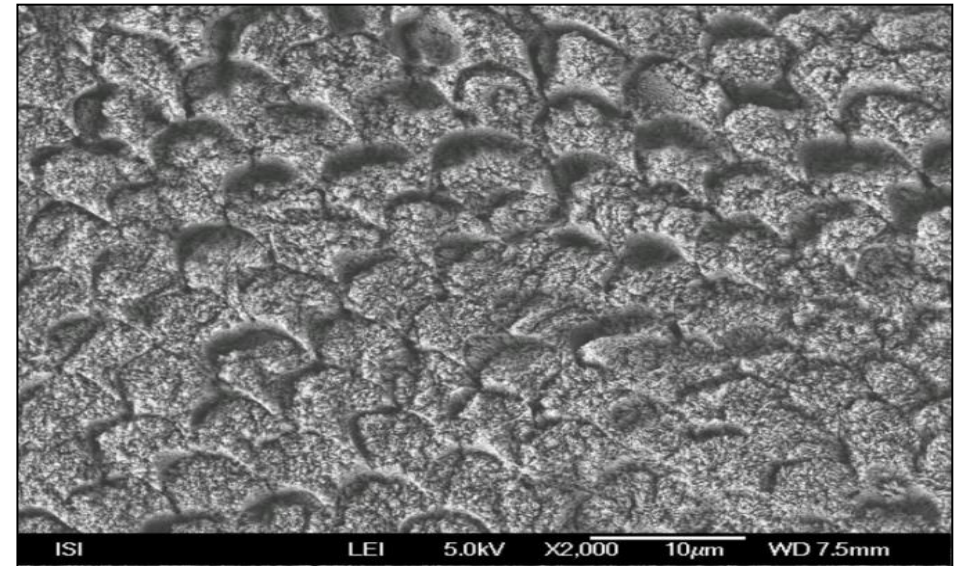
- Composite material is thick, it is not able to flow into these microscopic spaces – we need a flowable component – the bond.
- Bond is a resin of the same composition as organic matrix, it does not contain the filler – it flows into this retentive pattern.
- Bond comes together with the composite.



Acid on aprismatic enamel

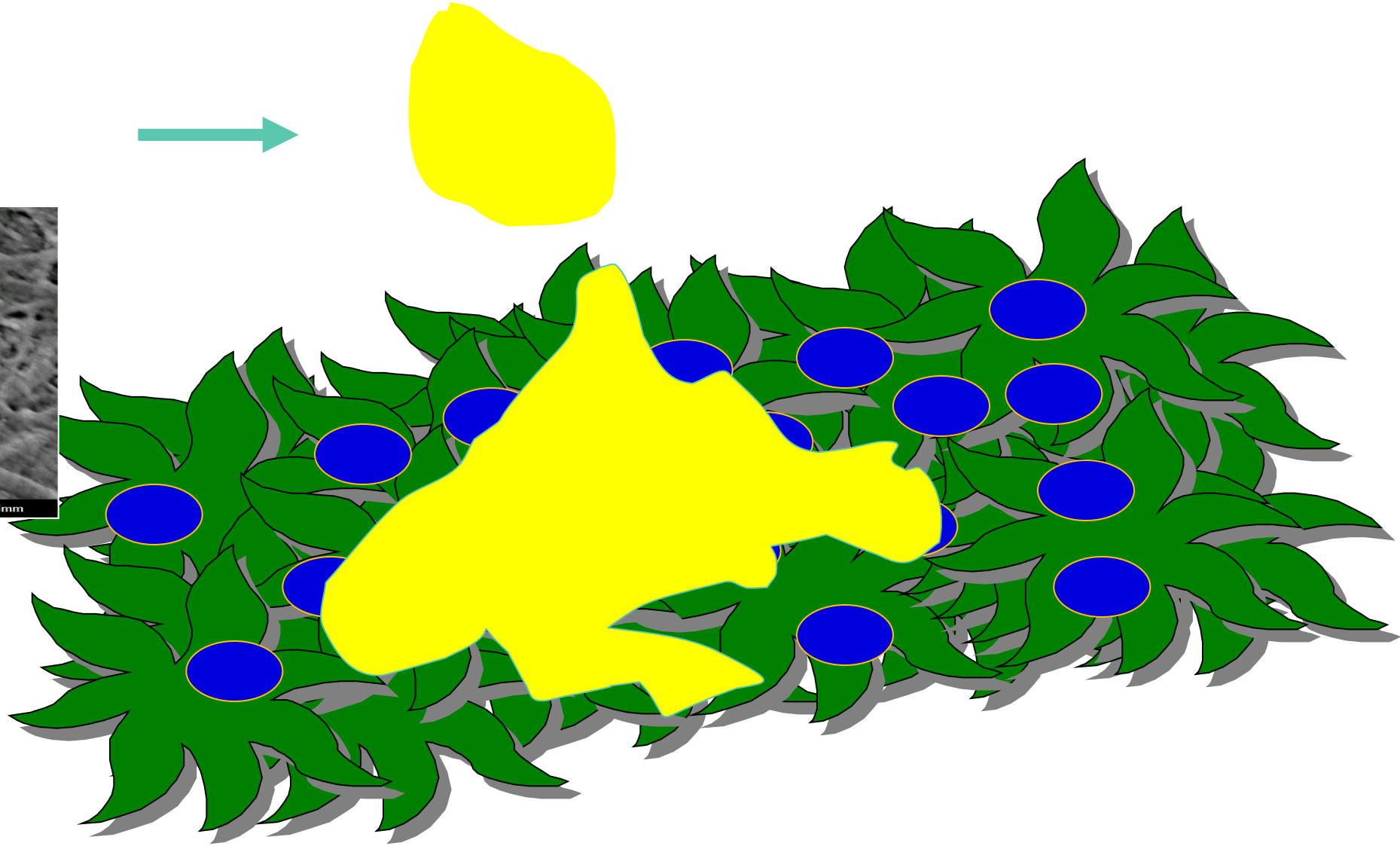
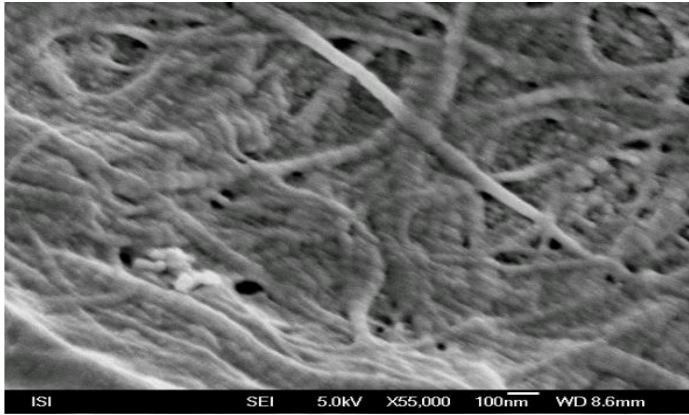


Acid on prismatic enamel



Dentin

Bonding agent



Adhesive system connects resin to enamel and dentin

- Bond is a hydrophobic resin principally of the same composition as composite filling material but without the filler or with a small amount of filler. It works in enamel. In dentin **primer** is necessary before bond.

Why?

Dentin – special composition

- More water – always wet
- Less minerals
- Low surface energy
- Smear layer

Composite is hydrophobic, we need hydrophilic substance

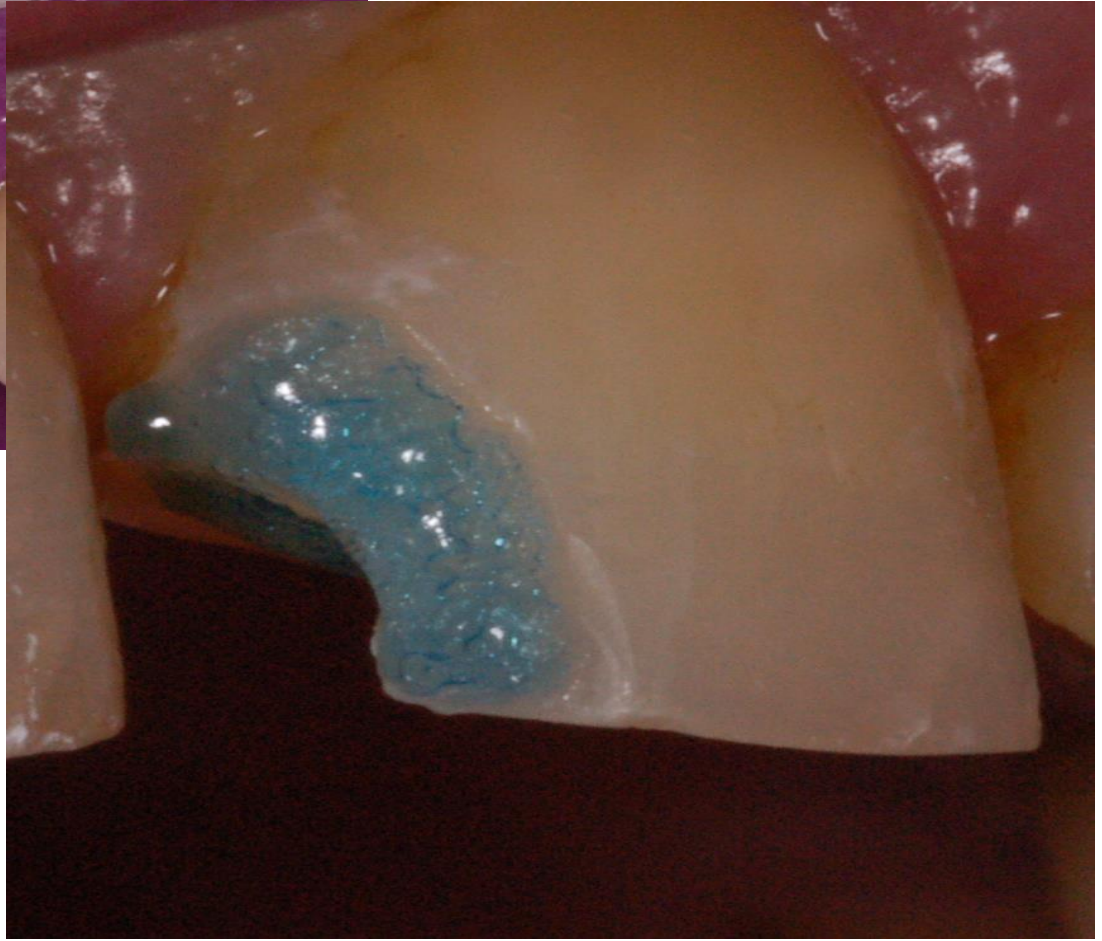
Adhesive systems contain resin monomers

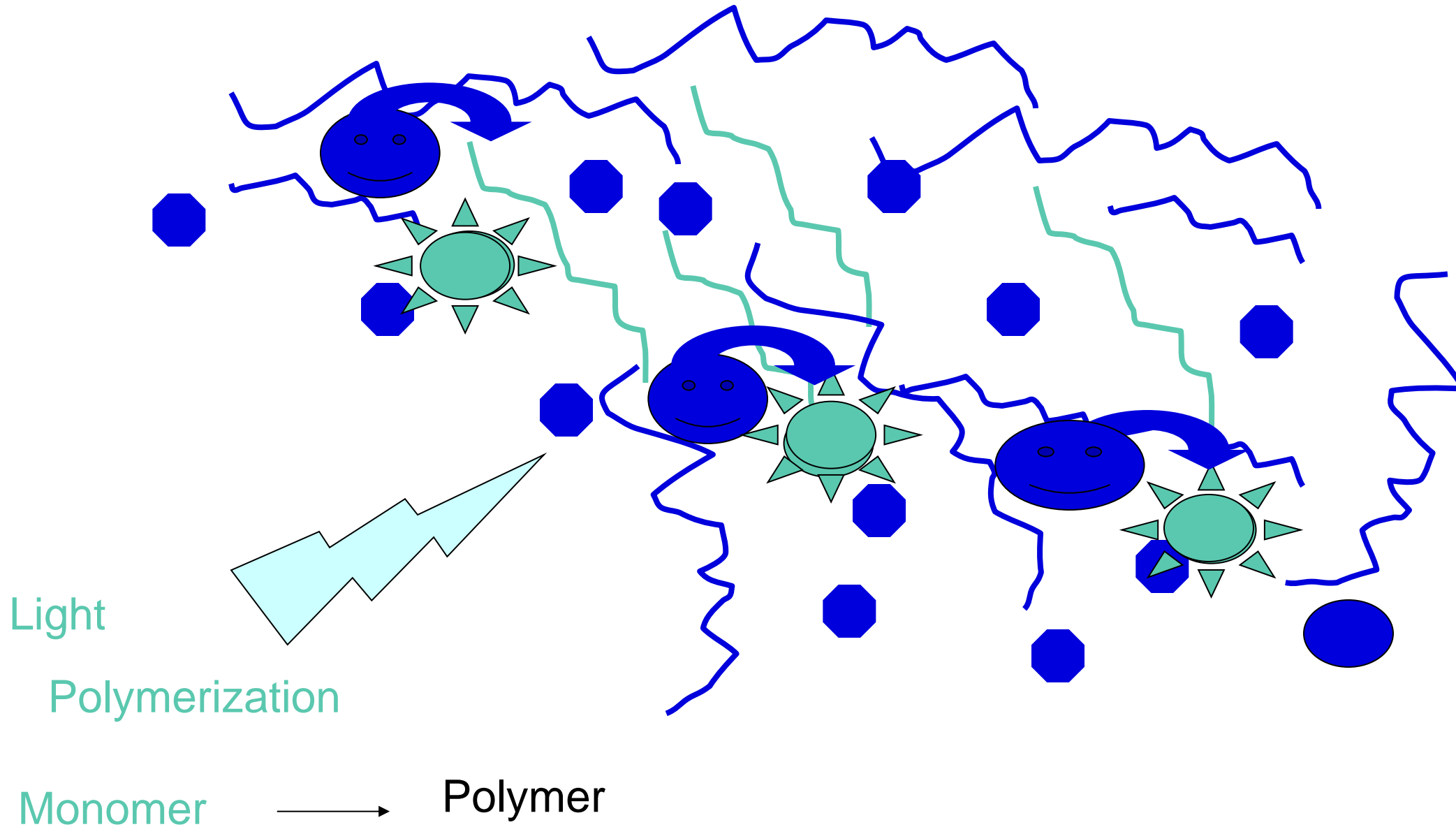
- Hydrophobic monomers - bond works in enamel it does not work in dentin without primer
- Amphiphilic monomers – hydrophobic + hydrophilic part - in primer

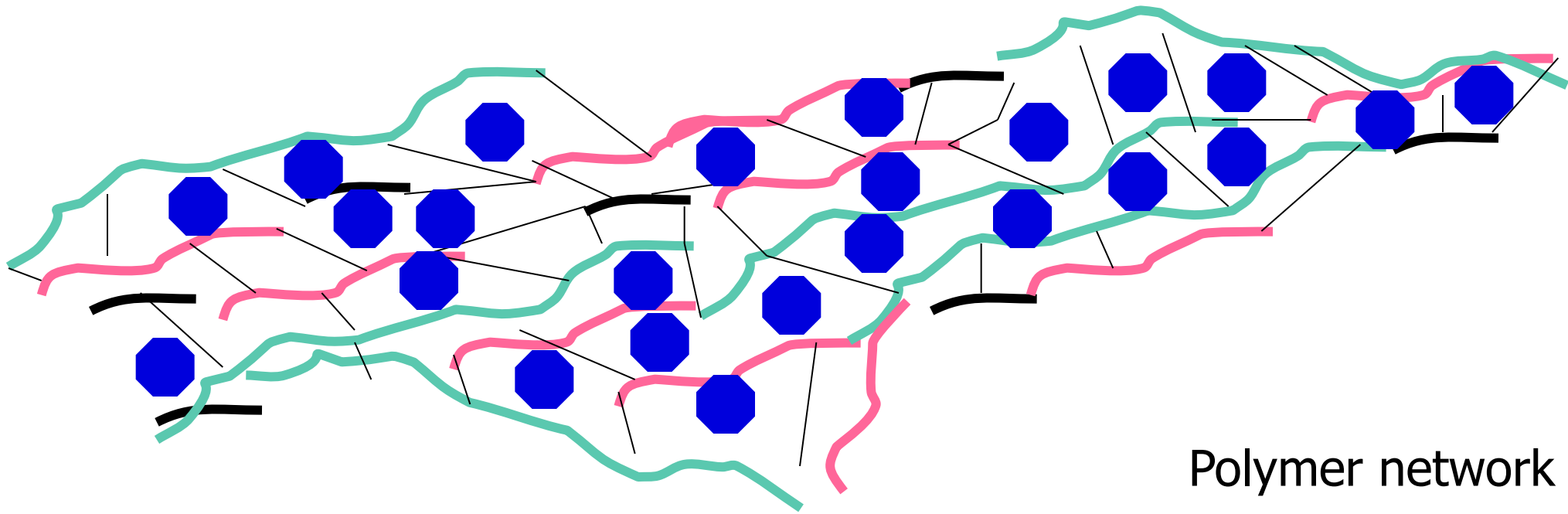
Primer is necessary for dentin.

The hydrophilic part flows into dentin (tubules, spaces in collagen network) and keep the collagen network open, the hydrophobic part of primer binds to hydrophobic bond that flows into dentin pretreated with primer-

If primer applied on enamel – residual of water can be removed.







Polymer network

Polymerization units

- Quarz halogen units (halogen lamp) appr. 40 s per layer
- LED units (diode – monochromatic light, need of more diodes)
Appr. 20 s per layer

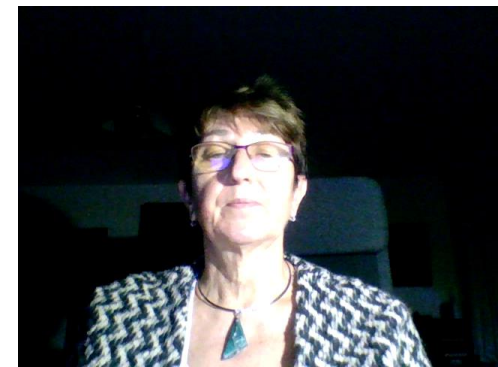
Absorbtion spectrum of fotoiniciators

| Photoinitiator | Absorbtion spectrum (nm) | Maximum (nm) |
|----------------|--------------------------|--------------|
| CQ | 440 - 500 | 470 |
| PPD | 380 – 430 | 400 |
| TPO | 350 - 410 | 380 |

We use blue light

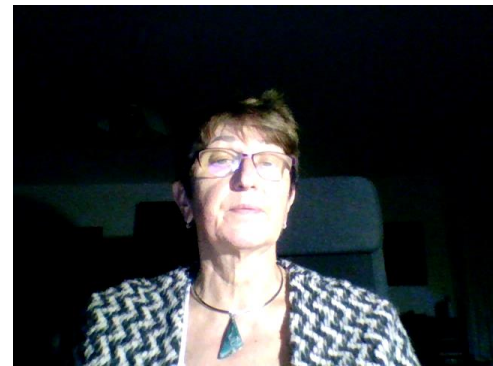
Indication of composite materials

- Filling of all classes:
- I., II. class: small to moderate restorations
- III. Class
- IV. Class
- V. Class
- *Other factors for consideration:*
- *Level of oral hygiene*
- *Occlusal loading*
- *Quality of hard dental tissues*



Contraindication of composite materials

- Bad level of oral hygiene
- Large cavities in posterior teeth (alternative is amalgam or inlay/onlay,
- Heavy occlusal stress (deep bite , bruxis)
- Cavities out of enamel (esp. cervical area)
- Social aspects





Sequence of operation

- Preparation
- Bevel the enamel in most cases (no in class I.)
- Acid etching (20s enamel, 10s dentine)
- Washing (the same time as etching, at least 10s)
- Removing access of water
- Priming and bonding – microbrush and air syringe
- Curing of the bond
- Layering of composite (1,5mm – for good curing)
- Finishing and polishing (extrafine diamonds, rubber instruments)

Air thin / Dry

