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Restorative dentistry IV1.

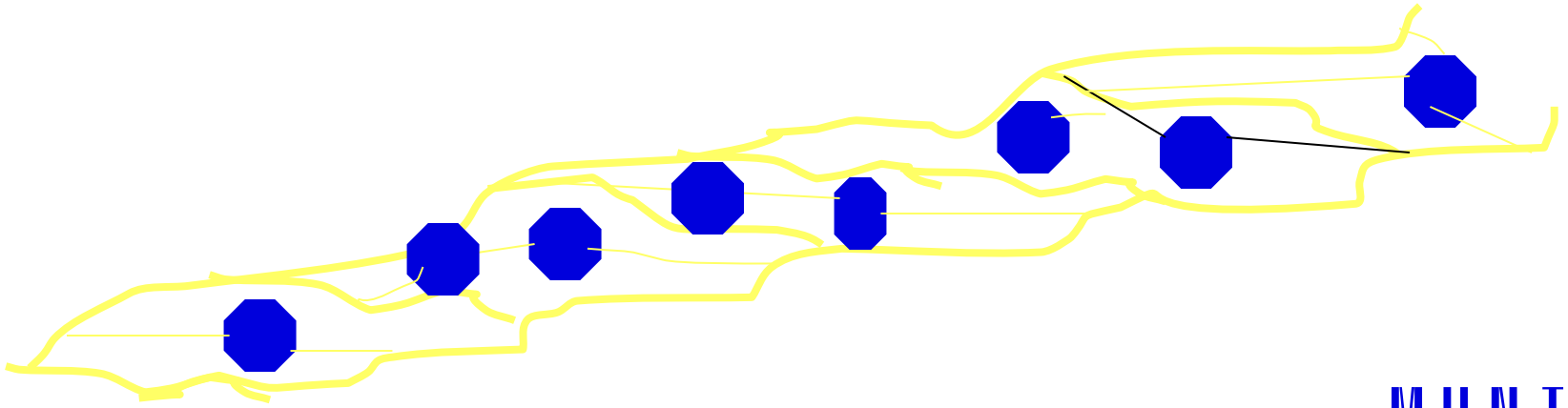
Repetition

Faculty of medicine, Dpt of restorative dentistry, ass.prof. L. Roubalikova

Composite materials

Chemically bonded mixture of organic

matrix and inorganic fillers



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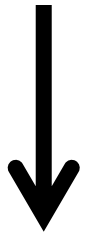
Coupling agent – binds organic matrix and the filler together



Homogenous distribution of the filler particles in the material

Excellent mechanical properties

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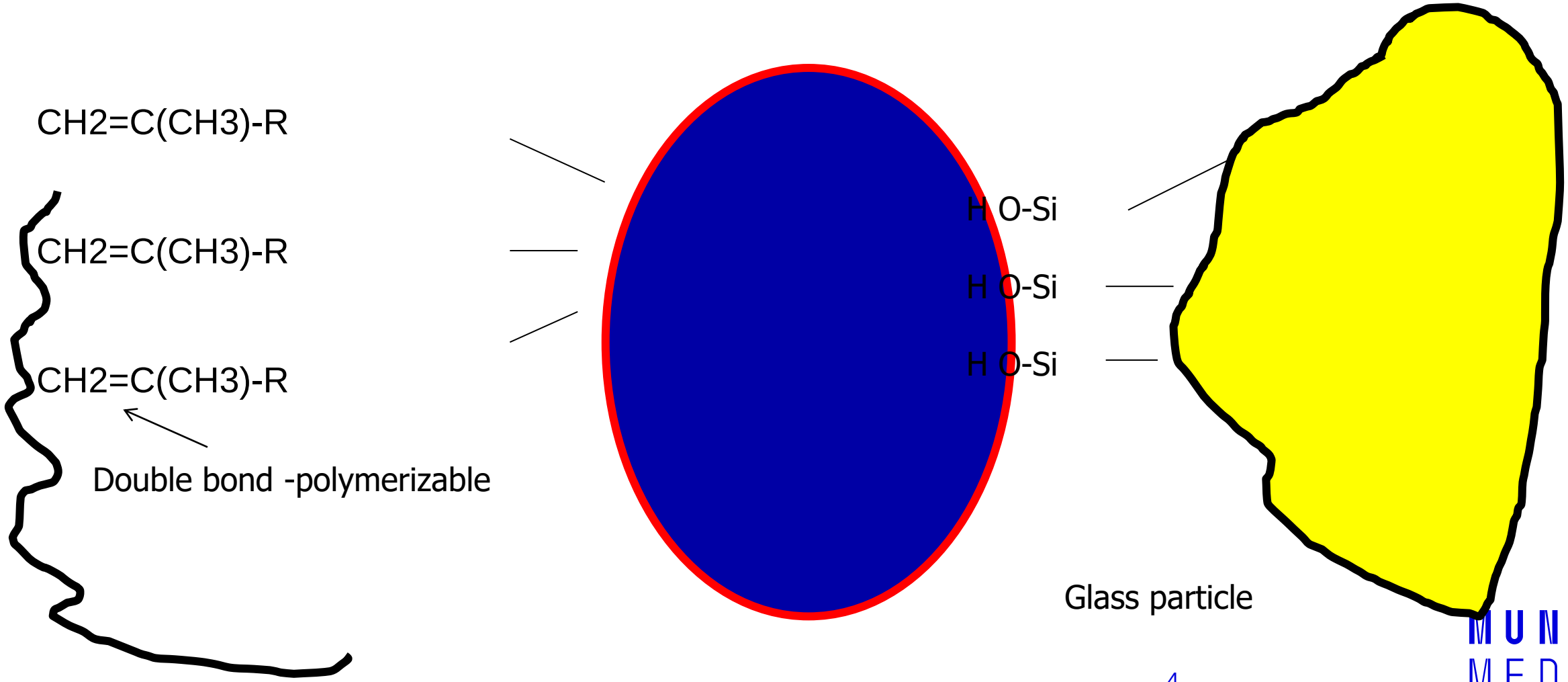
Binding of the coupling agents to glass particles



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Importance of the components

- matrix – a transfer mechanical loading on inorganic fillers, protects the filler against moisture
- filler - a support of the material, carries the loading
- coupling agents - a homogenous distribution of the filler in matrix

Kompozitní materiály podle plniva

- Makroplnivo - makrofilní
- Mikroplnivo – mikrofilní
- Kombinace – hybridní
  - konvenční hybridní
  - mikrohybridní

Kompozity s nanoplnivem

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Composition - matrix

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

• fenyl]propan)

• Bis DMA

• UDMA

• TEGMA /triethylenglykoldimethacrylate

• EGMA ethylenglykoldimethacrylate

• eBis –GMA

• HDMA hexandioldimethacrylate

<u>Dimethacrylates</u>

Composition – matrix

- Acid modified resins (compomers)
- Polysiloxan chains with polymerizable groups (ormocers)
- Silorans (ring opening monomers)

Filler

- Milled quartz
- Aluminimum silicate glass
- Silicium dioxide
- Prepolymer
- Complexes of microfiller (aglomerates)

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
- Aglomerates

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

Nanoparticles

- Particles 10 nm and less

Special technology, size, shape and binding to monomer

Coupling agent

- G -methacryloxypropyltrimetoxysilan (A 174)

Other components

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

Selfcuring composites

- Dibenzolyperoxide Tertiary amine

- Initiator Activator

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Light curing composites

Initiator and sometimes also activator

Camphorchinon CQ

Phenylpropandion PPP

Trimetylbenzoylphosphino xid TPO

Camphorchinon - CQ

- Yellow colour
- Activator: etyl-4-(N,N’-dimetylamino)benzoát (4EDMAB), N,N’-dimetylaminoetylmetakrylát (DMAEMA)
- Light shades of composites: combination of CQ and other initiators.

Composite materials – basic characteristics

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

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Classification of composite filling materials

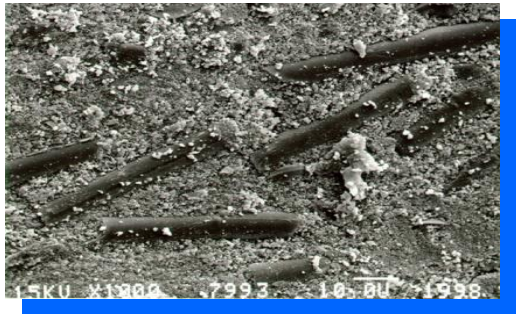
- Size of the filler particles

Macrofilled, microfilled (homogenous, non homogenous, hybrid)

- Matrix (monomers)

Dimethacrylate, acid modifies, ormocers, silorans

- Viskosity (flowable, thick)



History

Dimetacrylates
Bowen 1960 – Bowen´s monomer

Buoconore 1955 – acid etching

History

Fusayama 1979
Adhesion to dentin
Yoshida. Nakabaiashi
Van Meerbeck


OptiBond
Self-Etch Adhesive
2
1
Prime
Simplicity
1
Simplicity
2
G-BOND
5mL
0086
AdheSE
1
AdheSE
2
3M ESPE
Adper™
Scotchbond™
Multi-Purpose
Adhesive
7543
Single Bond
Adhesive

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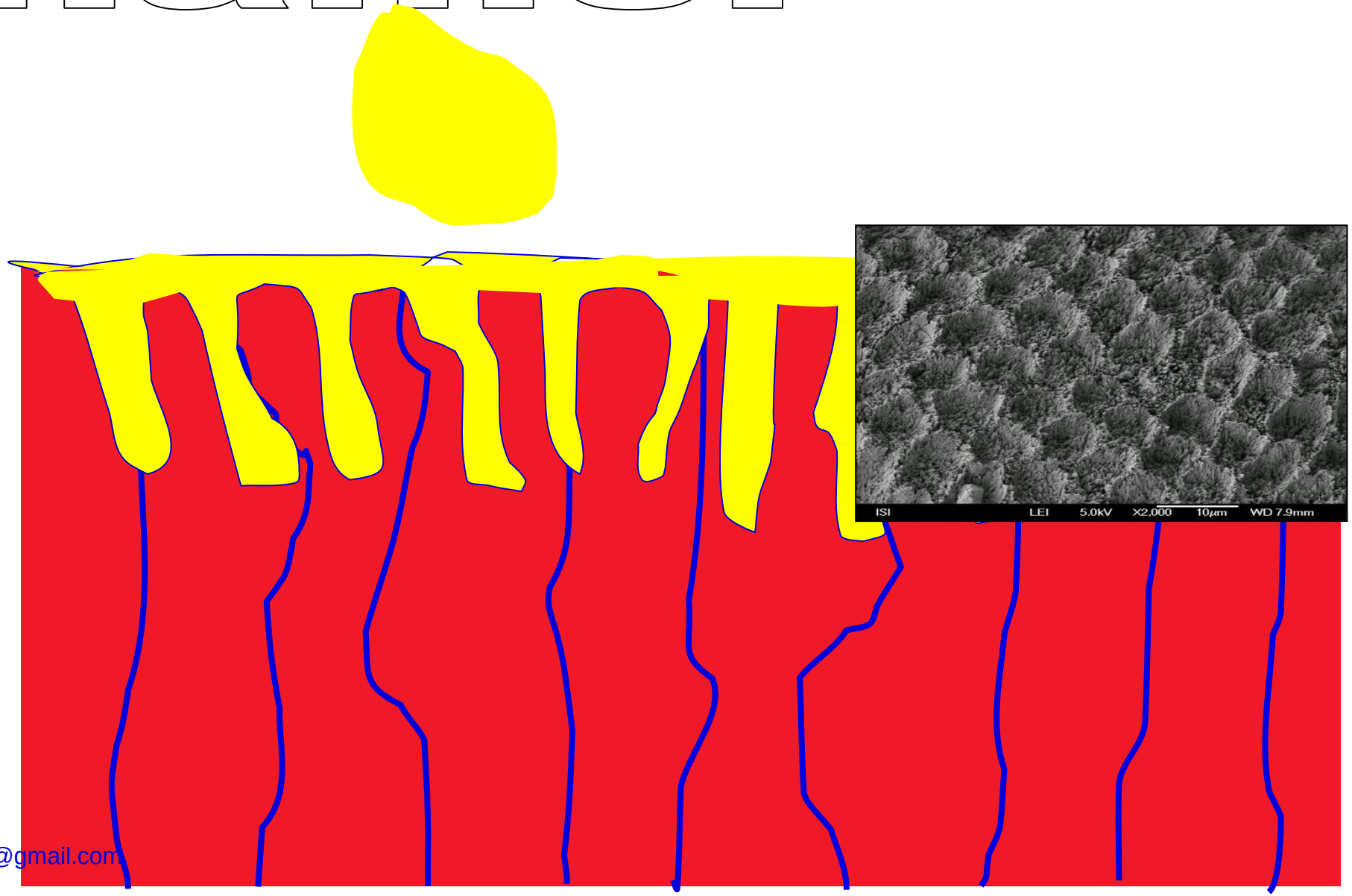
Adhesion

- Mechanical adhesion

- Specific adhesion
  - Intermolecular forces
  - Chemical binding

Enamel



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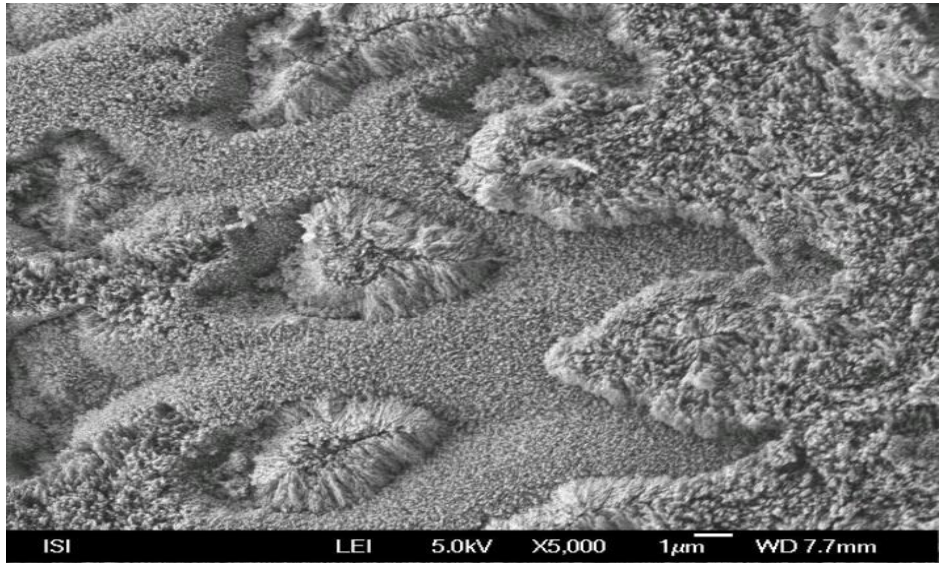
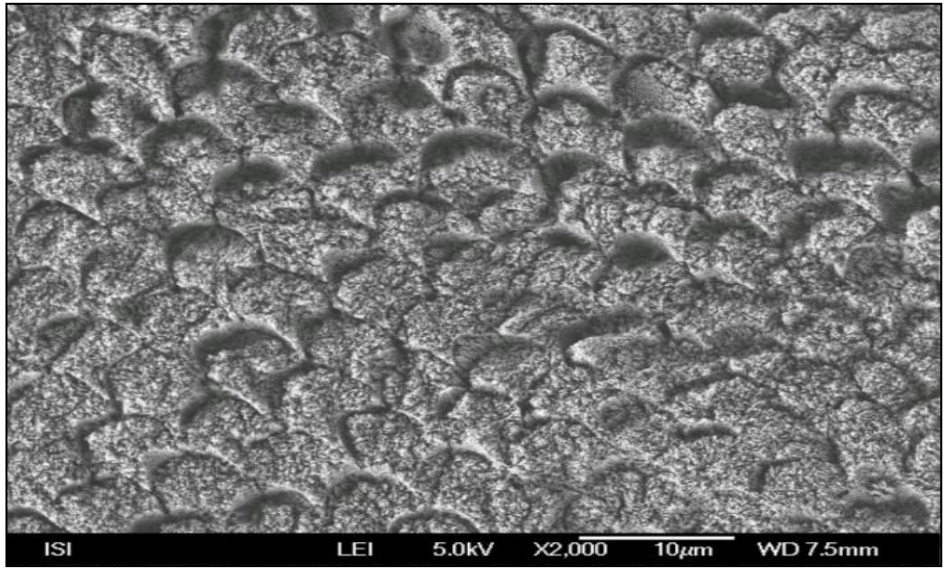
Acid on aprismatic enamel



Acid on prismatic enamel



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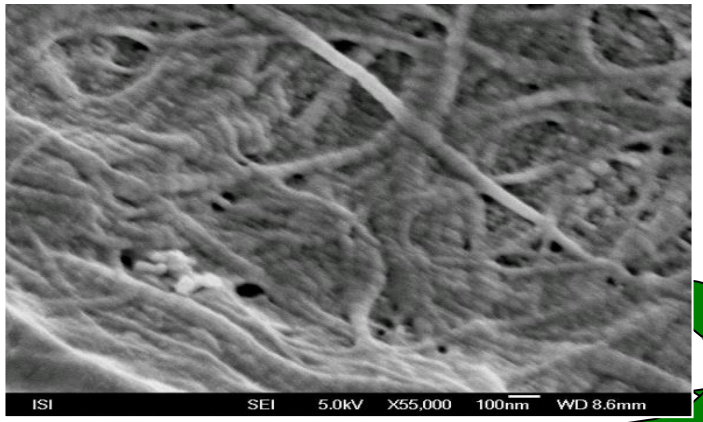
Dentin – special composition

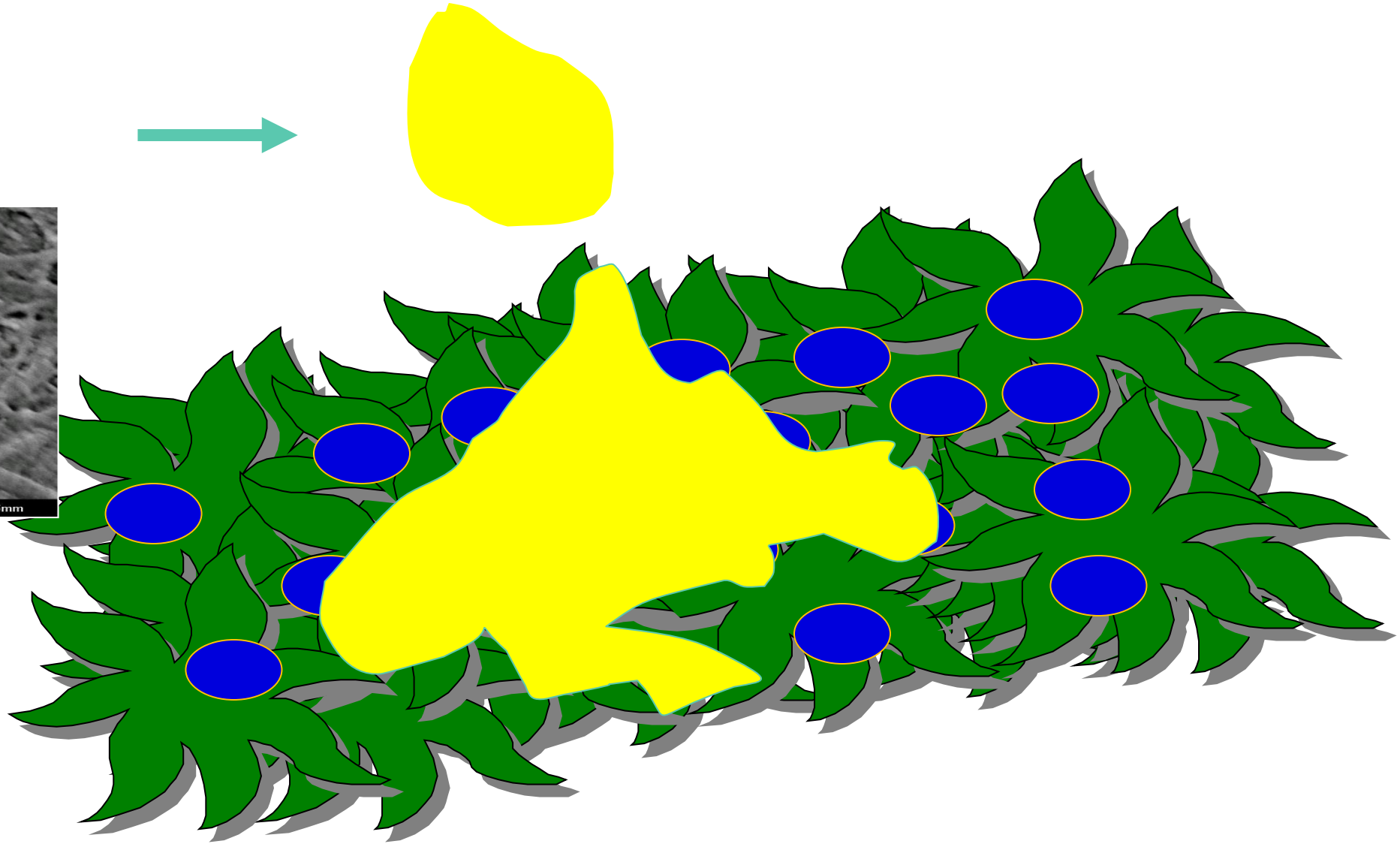
- More water – always wett
- Less minerals
- Low surface energy
- Smear layer

Composite is hydrophobic, we need hydrofilic substance

Dentin

Bonding agent





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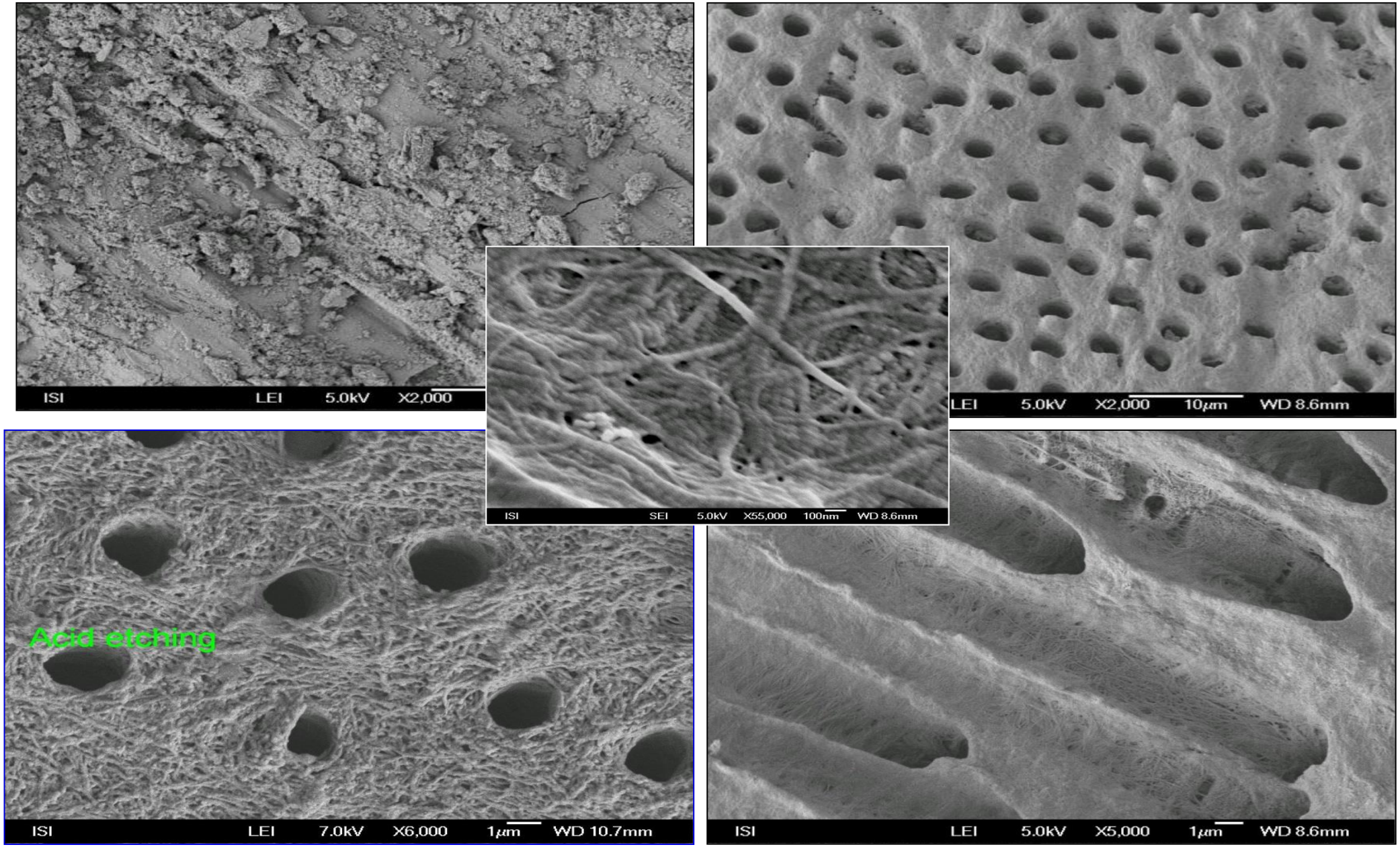
ISI LEI 5.0kV X2,000
LEI 5.0kV X2,000 10μm WD 8.6mm
ISI SEI 5.0kV X55,000 100nm WD 8.6mm
Acid etching
ISI LEI 7.0kV X6,000 1μm WD 10.7mm
ISI LEI 5.0kV X5,000 1μm WD 8.6mm

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Adhesive systems contain resin monomers

4-META •

HEMA •

TEGMA •

PENTA P •

5-NMSA •

Bis-GMA

Adhesive systems contain resin monomers

- Hydrophobic monomers - bond Works in enamel Does not work in dentin without primer
- • Amphiphilic monomers – hydrophobic + hydrophilic part - primer

Primer is necesssary for dentin. If applied on enamel – residual of water can be removed.

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Dissolving agents

- Aceton
- Alcohol
- Water
- Water/alcohol

Clinically oriented classification of the adhesive systems acc to number of steps

Acid etching	**Rinsing**	**Priming**	**Bonding**
Acod etchin	**Rinsing**	**Priming a bonding**	
Selfetching priming			**Bonding**
Selfetching bonding)			

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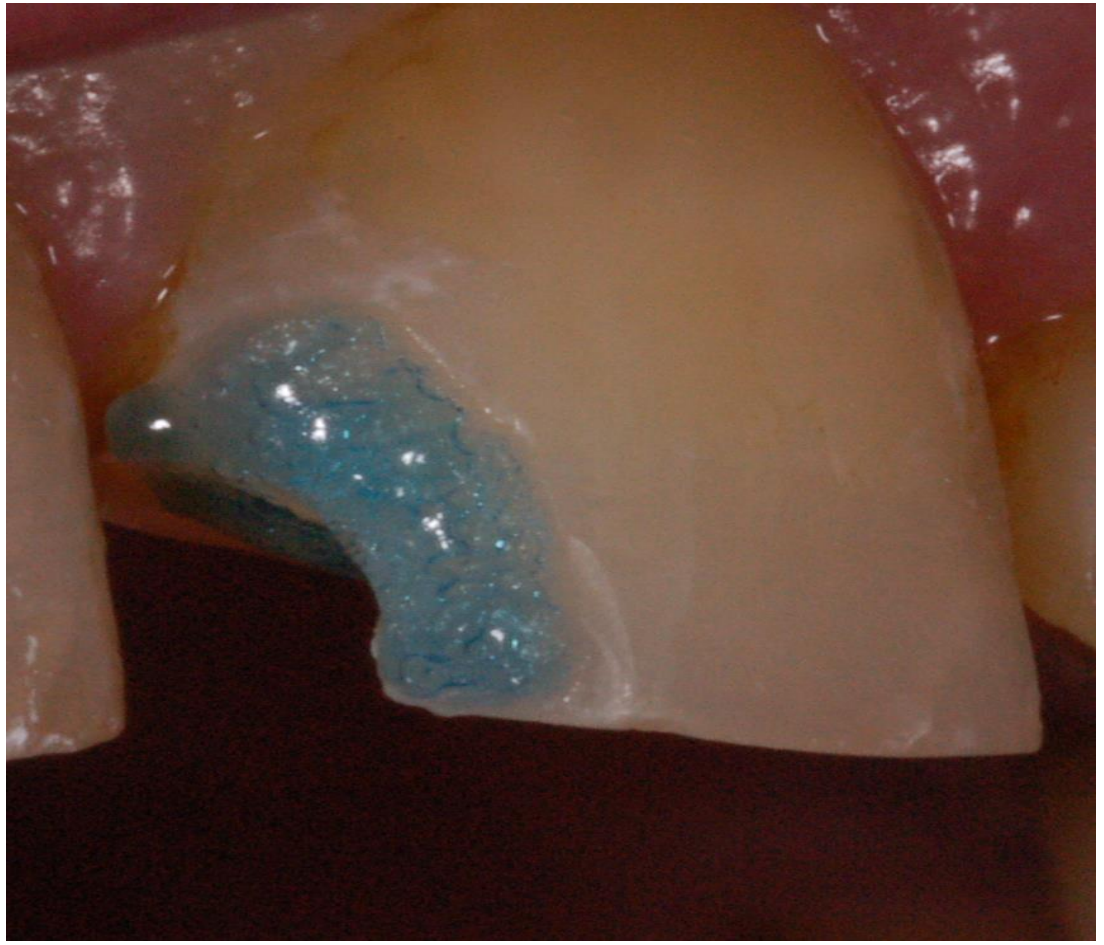

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Selfetching bonding agents

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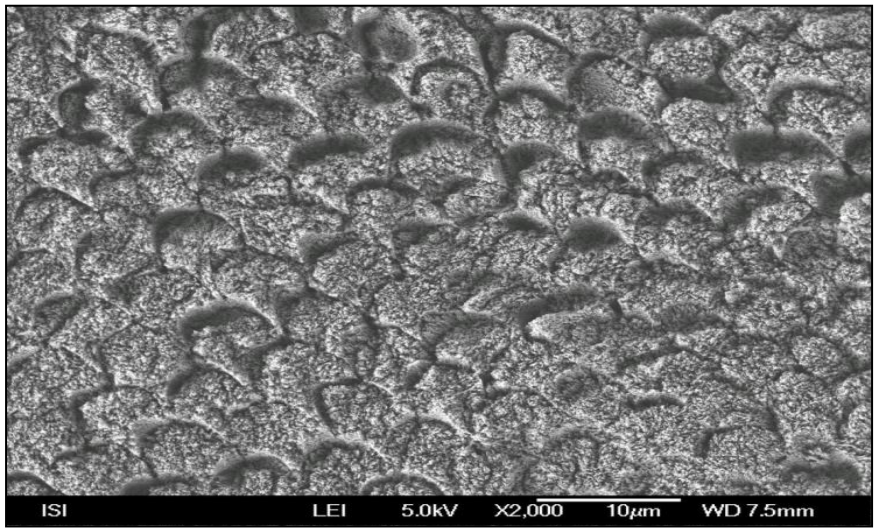
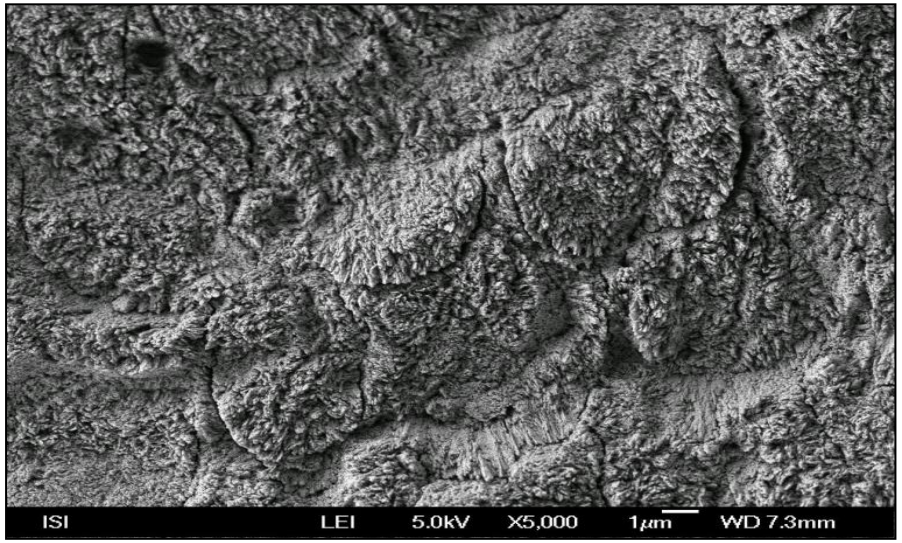
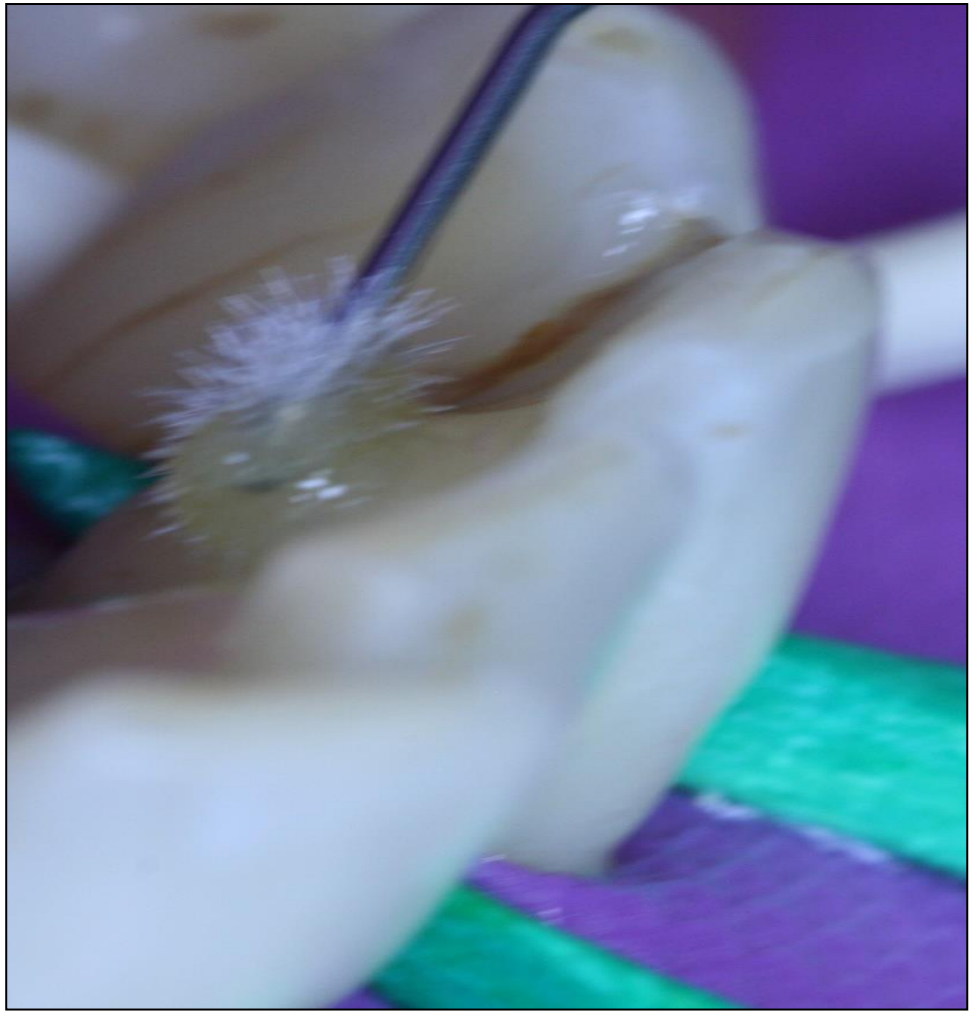


TE – Total etch,
ERA



SE – Self etching
SEA

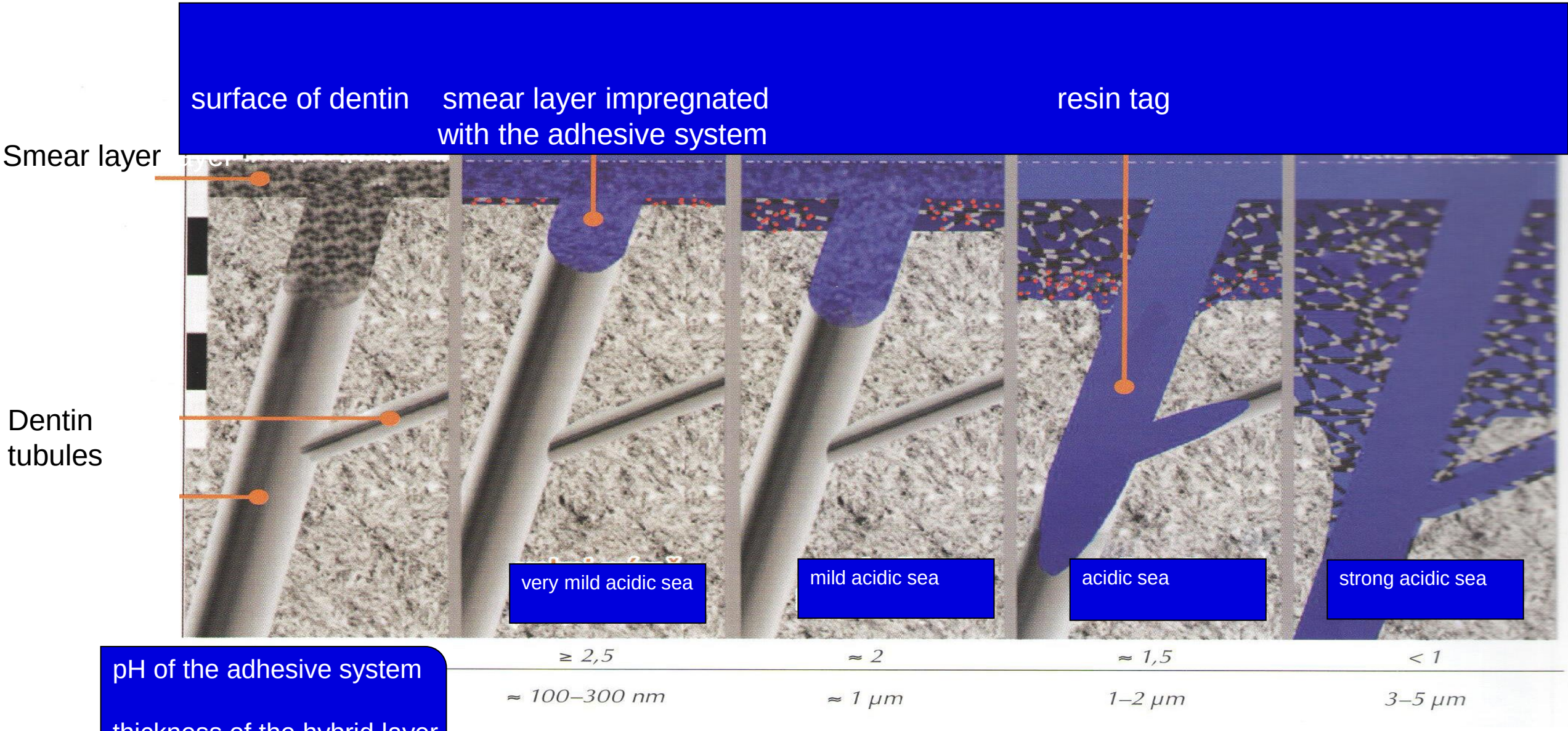


Two steps selfetching agents

Acidic hydrophilic primer – evaporation of the solvant, penetration, dissolving of the smear layer
Hydrofobic bond – sealing of the surface

One step selfetching agents

More vulnerable bonding, risk of hydrolysis



Source: Dudek M. Adhezivní spoj a adhezivní systémy I. LKS 11/2013

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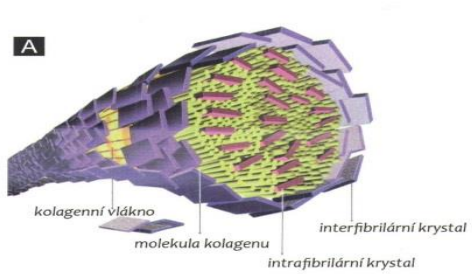
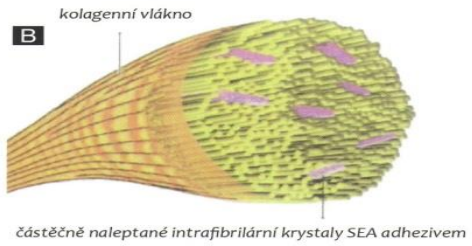
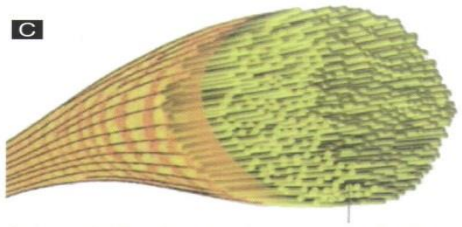


Colagen fibers with interfibrilar and
Instrafibrilar crystals od hydroxyapatite



Colagen fibers with intrafibrilas crystals
of hydrpoxyapatite only



Colagen fibers without crystals
of hydroxyapatites

Zdroj obrázku: Dudek M. Adhezivní spoj
a adhezivní systémy I. LKS 11/2013

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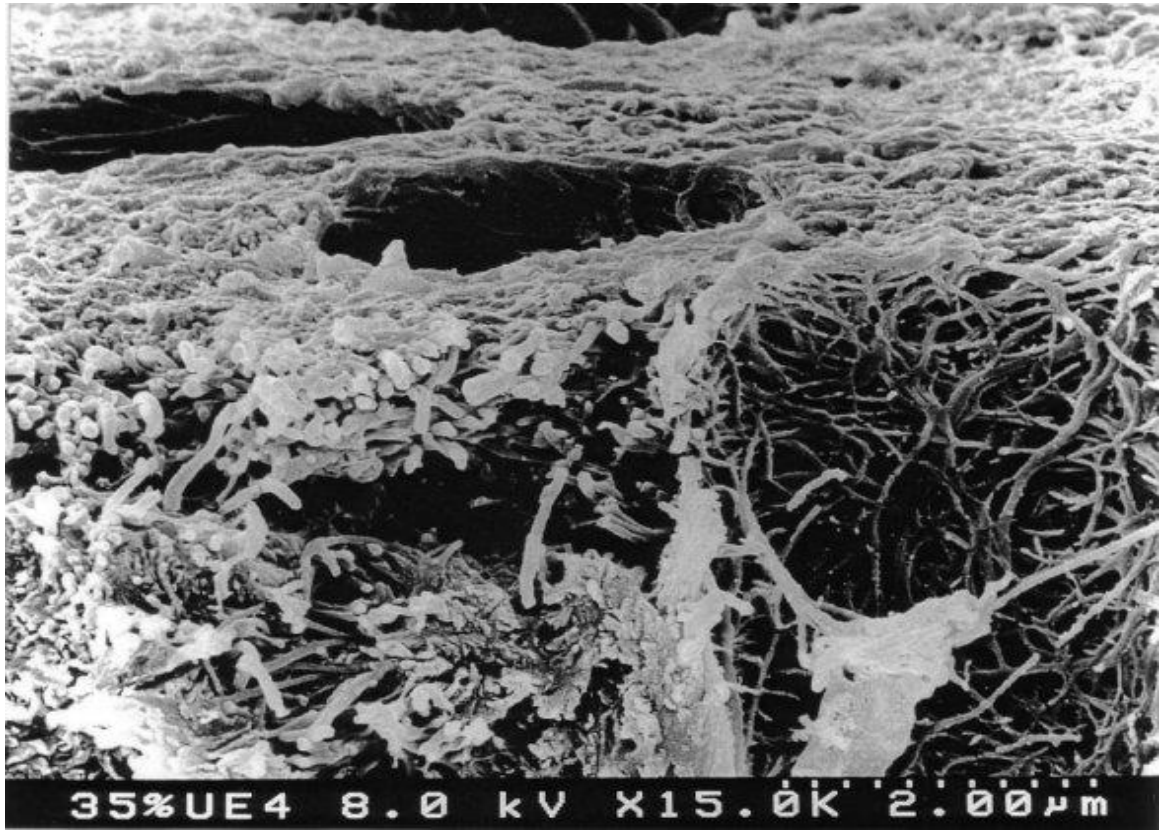
Importance of hydroxyapatite

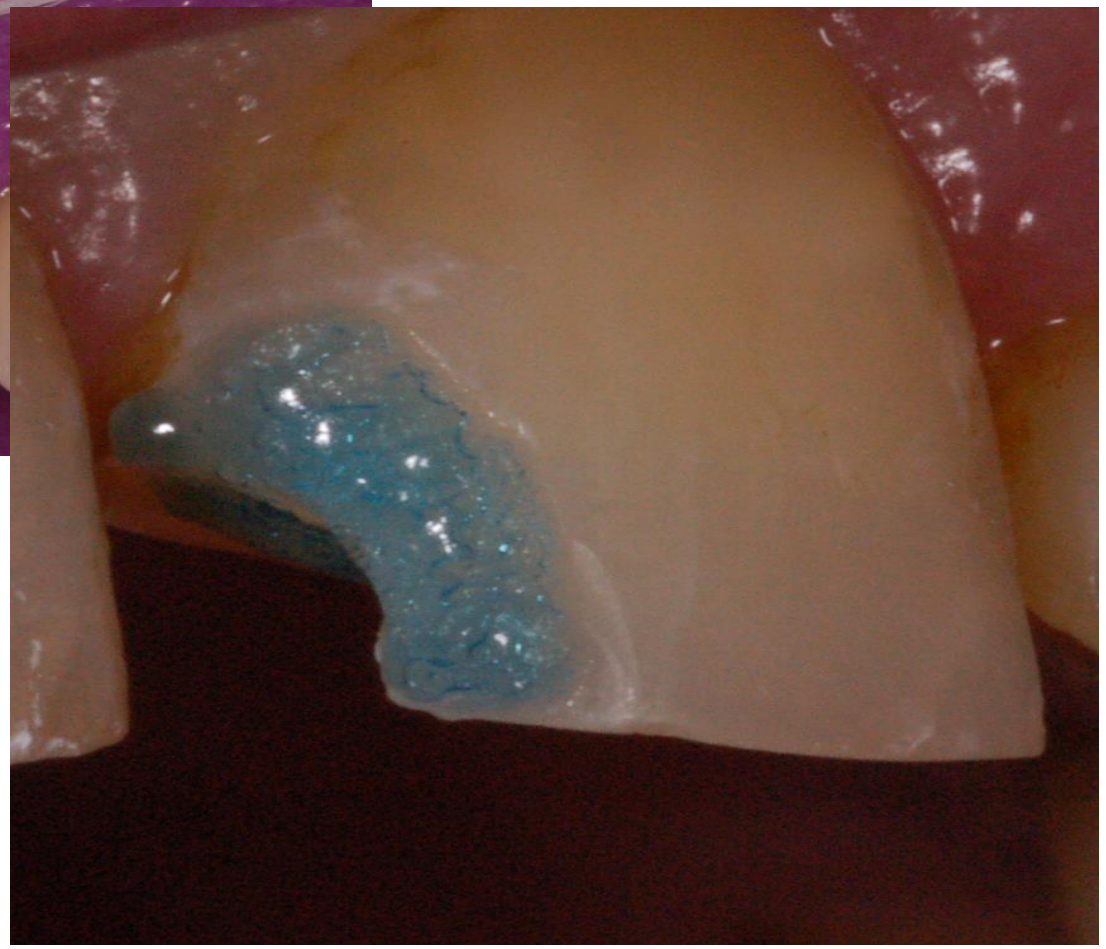
– Protection of collagen against hydrolysis

as well as enzymatic degradation of collagen (due to activation of matrix metaloproteinasis)

- Strong mineral acid id dangereous for good long term bonding
- Clorhexidin for one minute can stabilize collagen



Enzymatic degradation of collagen



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Factor that influence the quality of bonding

Structure and composition of hard dental tissues

Quality of their surface – esp. presence of smear layer, contamination with moisture, saliva and blood

Configuration factor – C- factor

Mechanical loading of the adhesive connection

Oral environment and external chemical materials (tooth pastes, asntiseptics, bleaching agent rtc.)

Polymerization stress depends on

- Quality of the material
- C- factor
- Mode of application
- Mode of polymerization

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Polymerization stress depends on

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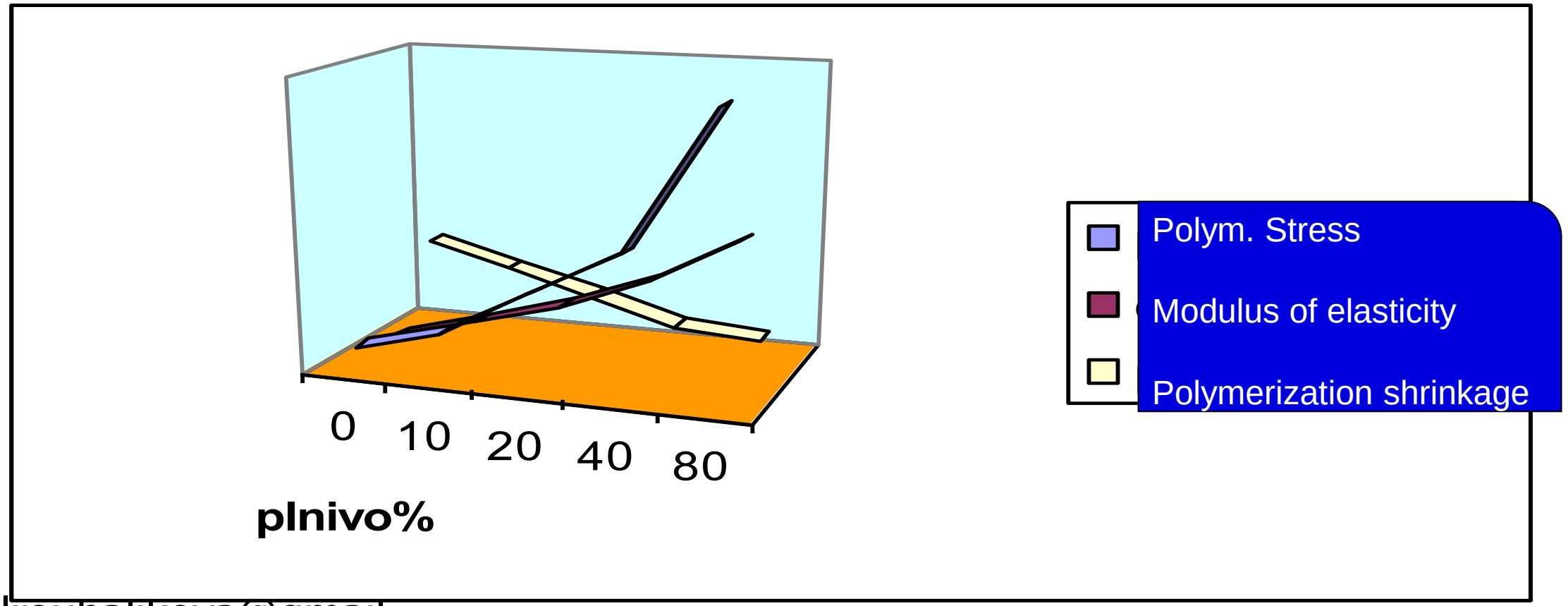
High content of filler increases the modulus of elasticity
High modulus of elasticity increases the polymerization stress
High content of filler decreases the polymerization shrinkage



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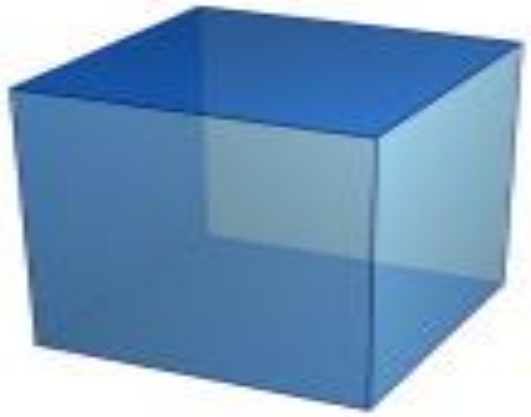
Polymerization stress depends on

- Quality of the material
- C- factor
- Mode of application
- Mode of polymerization

5

2



1

Bonded area : Free area
1:1 and less - optimal

Polymerization stress depends on

- Quality of the material
- C- factor
- Mode of application
- Mode of polymerization

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Mode of application

- **Incremental technique**

Layer by layer with big free surface

- *Importance of flowables*

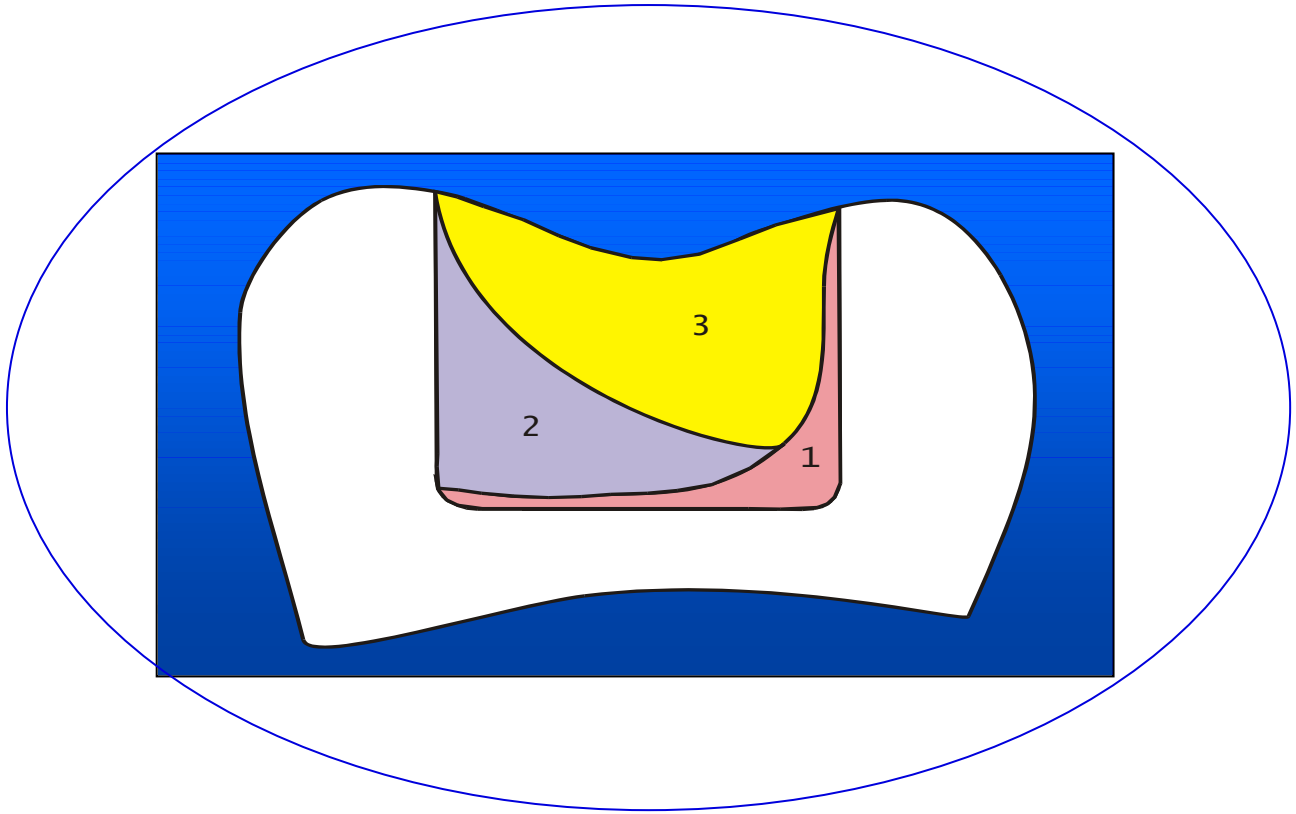
Thin layer of flowable first –big free surface

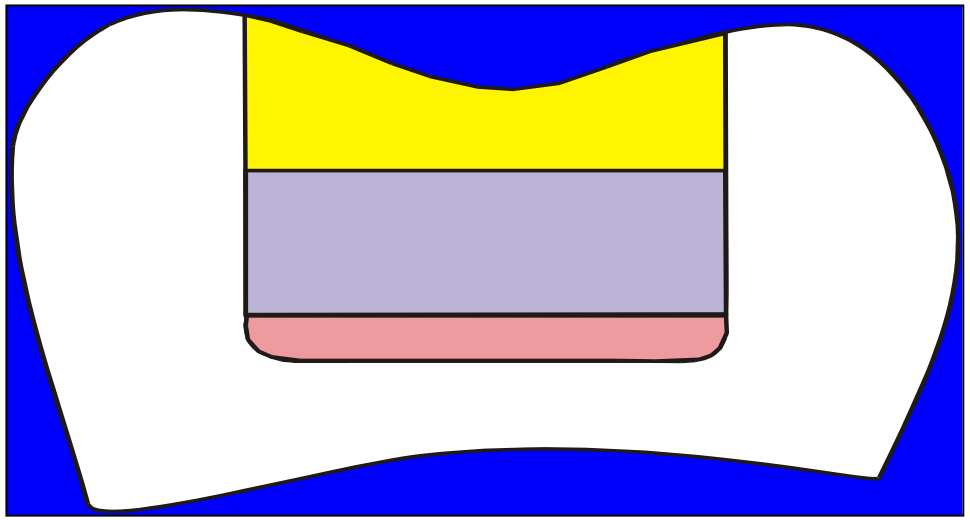
Good marginal adaptation

Compensation of the stress of the other layers

Bulk fill materials do not solve the problem with polymerization stress

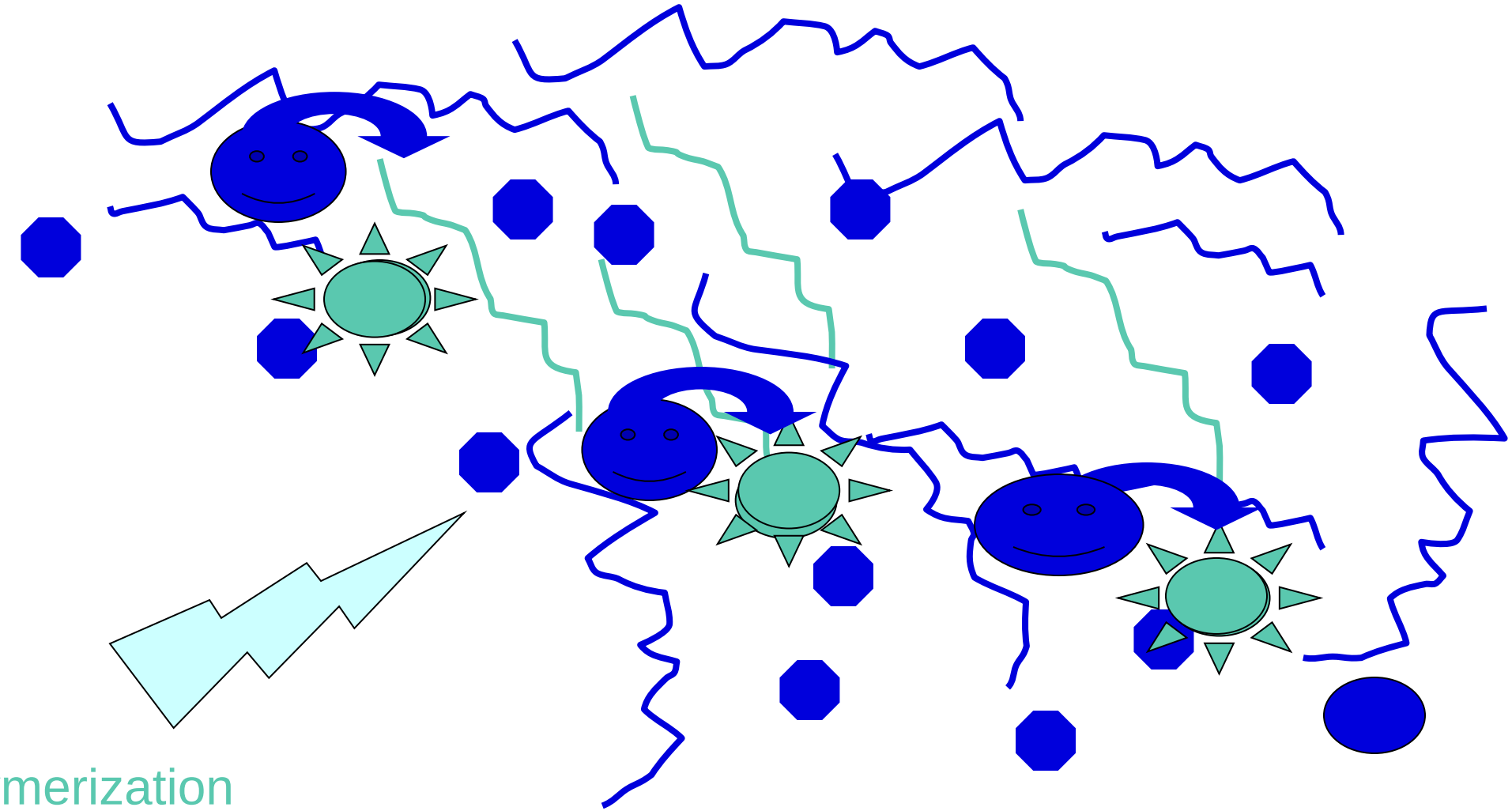
Placement of the material





Polymerization stress depends on

- Quality of the material
- C- factor
- Mode of application
- Mode of polymerization

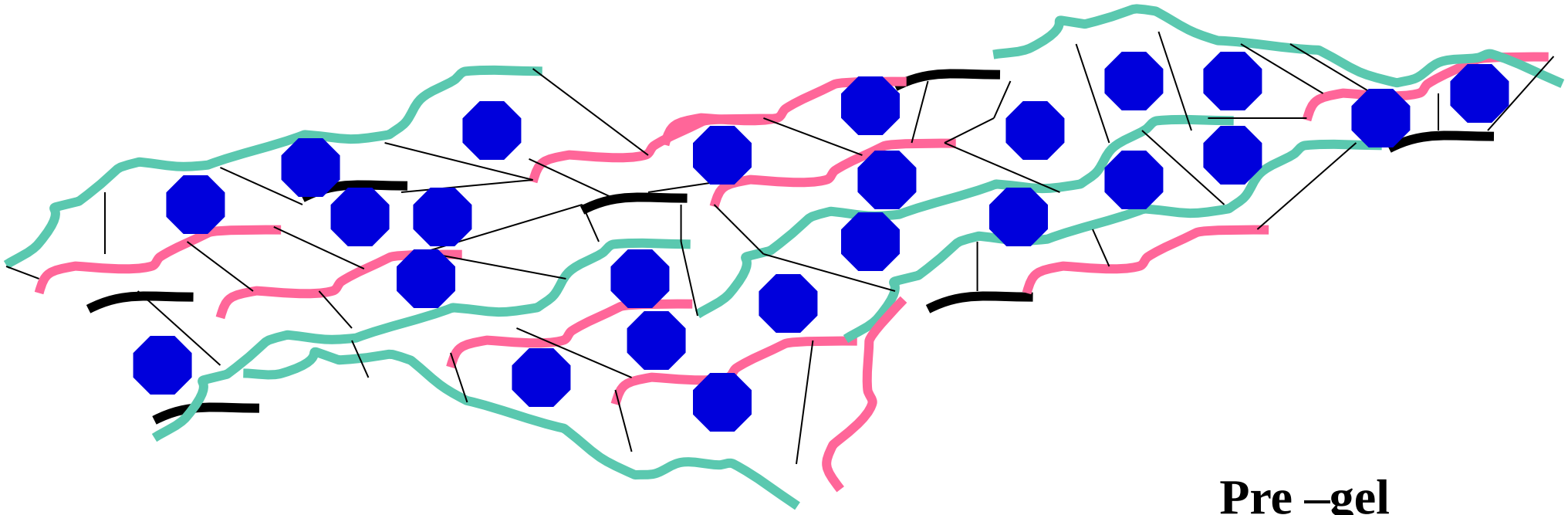


Light

Polymerization

Monomer ⟶ Polymer

Pre gel phase should be long – soft start !!!!



Pre –gel
Gel
Post -gel

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Three phases

Phases

- Pre-gel – material is soft
- Gel-point – material became hard
- Post –gel – material is not soft, postgel shrinkage

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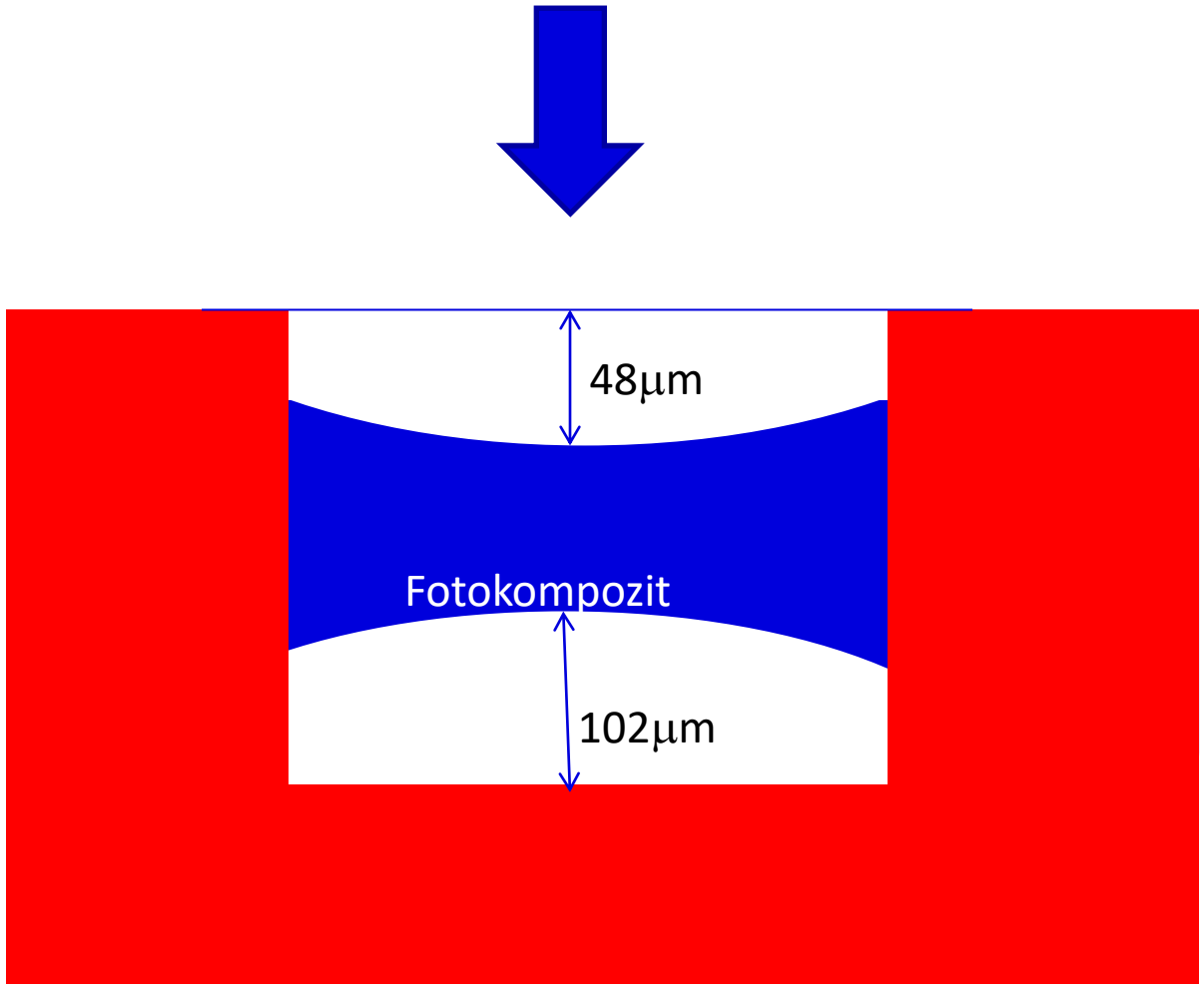
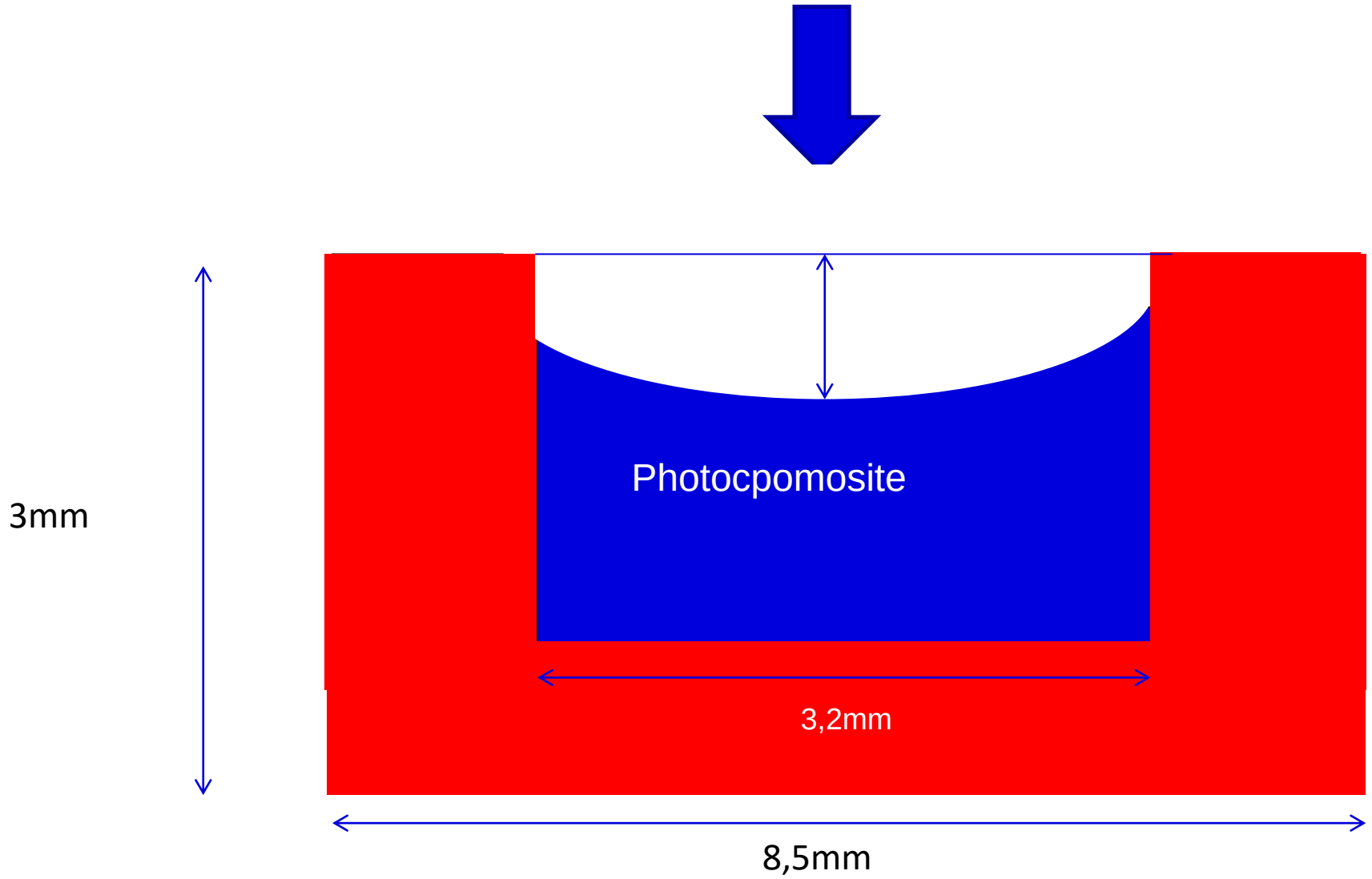
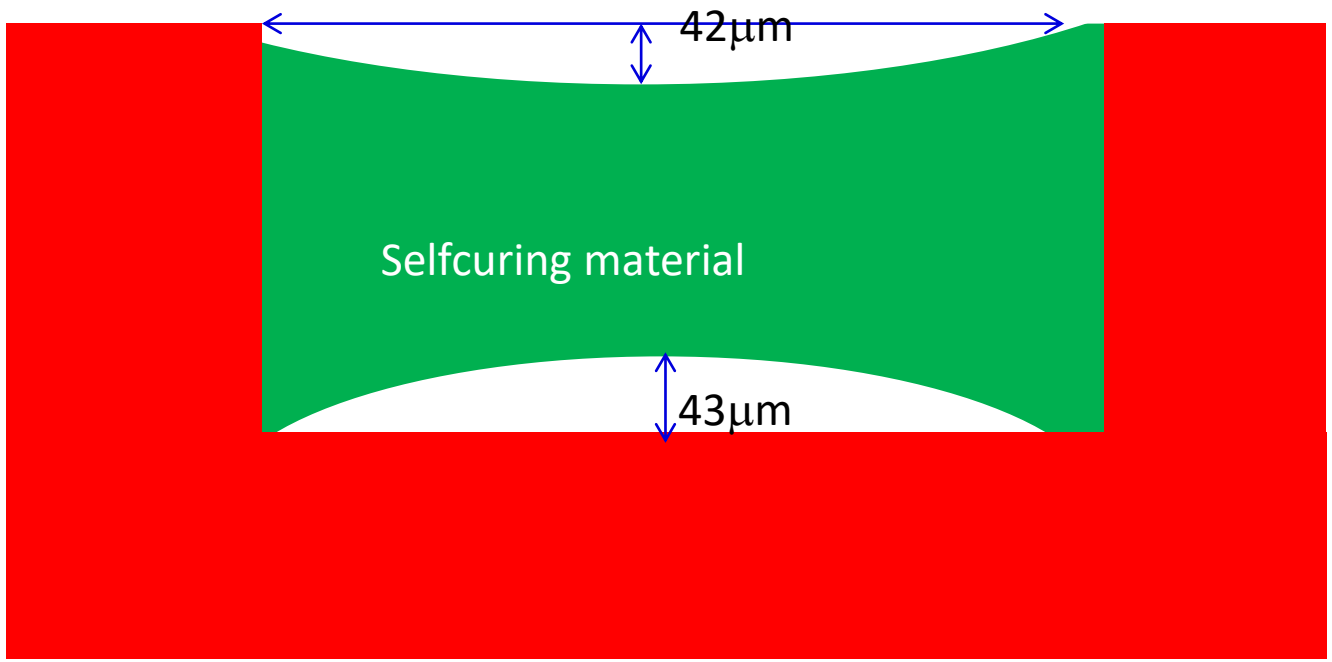

48µm
Fotokompozit
102µm


Photocpomosite
3mm
3,2mm
8,5mm


42µm
Selfcuring material
43µm

Duration of pre-gel phase

- Longer pre-gel phase is better for releasing of polymerization stress
  - Soft start
  - Combination of materials (selfcuring composite materials have longer pre gel phase)