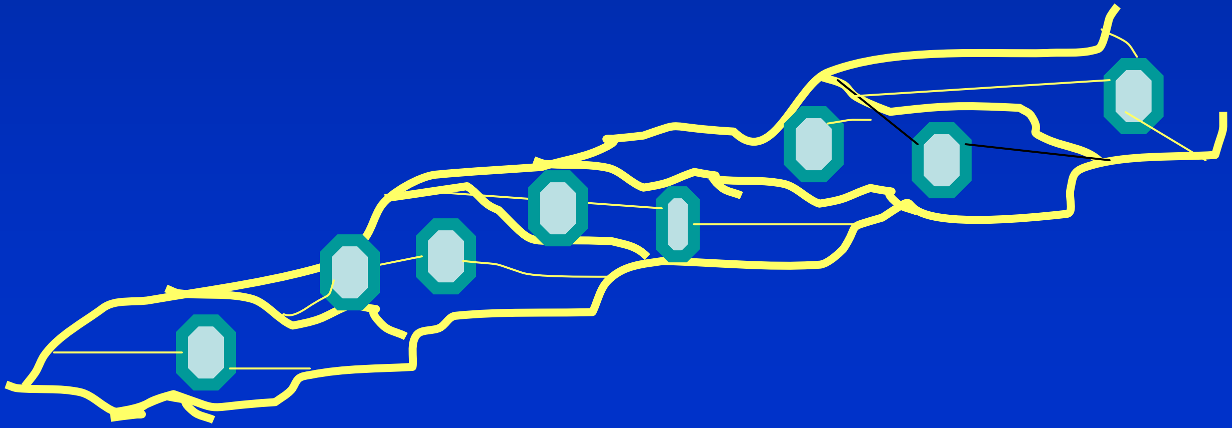
Contemporary trends

- Minimally invasive approach
- Adhesive materials and techniques

oach

Composites

Chemically bonded combination of organic matrix and inorganic filler



Natural composites

Composition

- **Organic matrix is a resin**

Bowen´s monomer Bis GMA (result of Reaction of Bisphenol A and glycidyl methacrylate)

UDMA

Oligomer - dimethacrylate

TEGMA

Composition

Filler

Milled quartz

Aluminium silicate glass

Silica (SiO_2)

Prepolymer

Coupling Agents

Silane

Composition

Iniciators and accelerators (activators)

Other components

Pigments

UV absorbers

Antioxidants

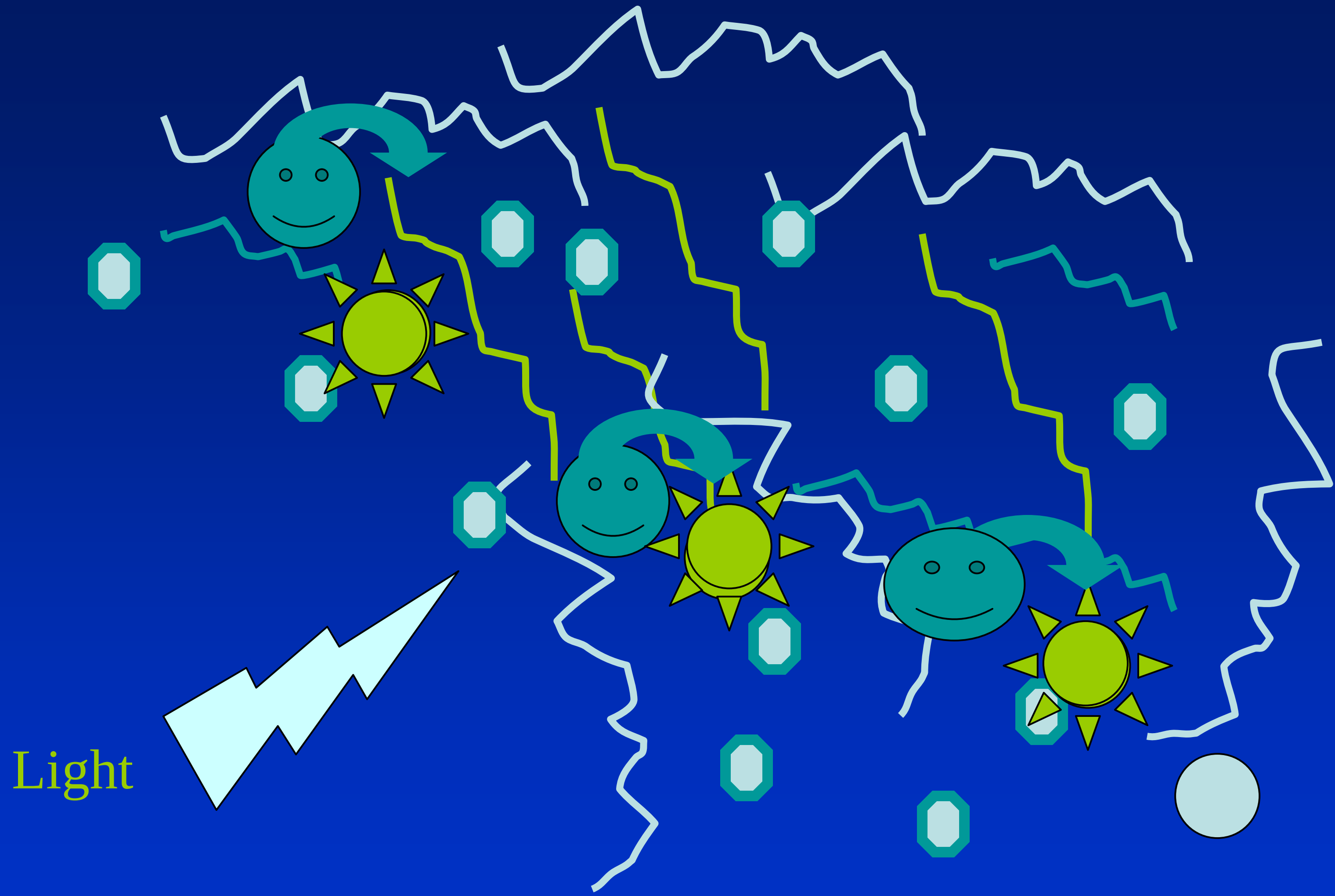
Polymerization

Accelerator

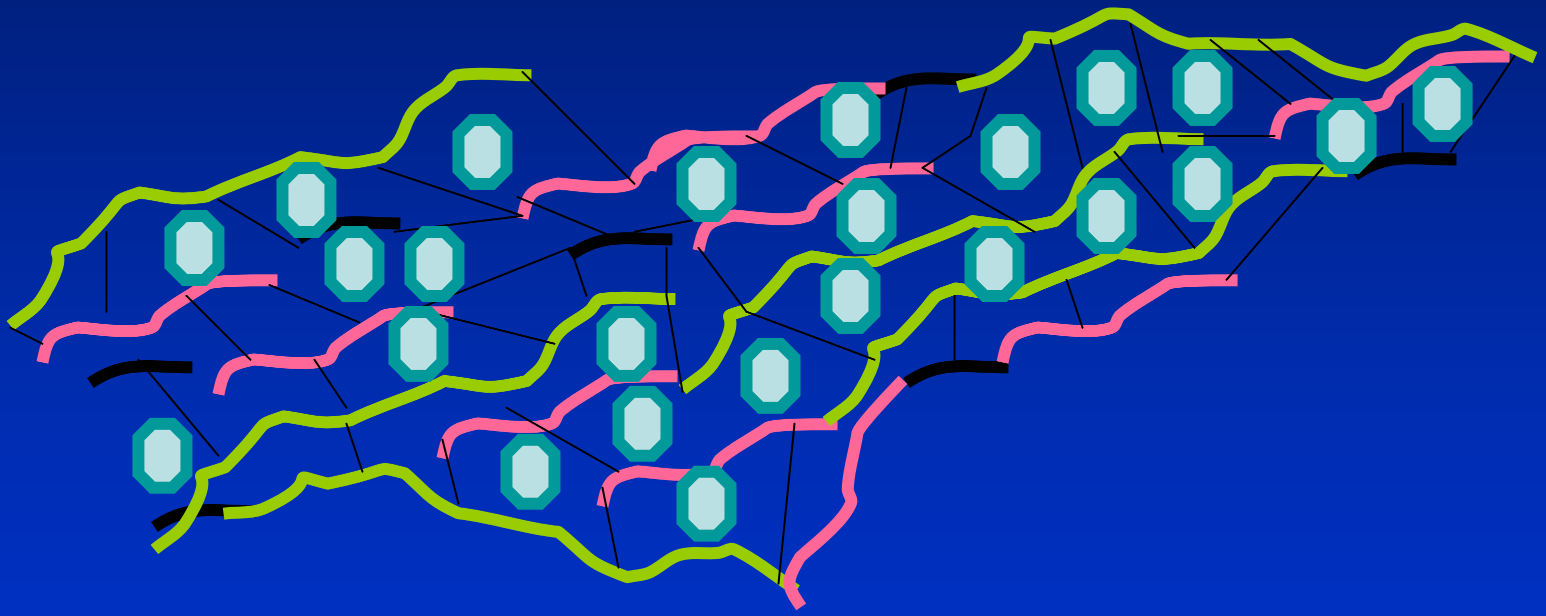
Iniciator

Double bonds - split

Polymer network


Light

Polymer network



Curing

- Light cured composites

- Light activated.

Light activation is accomplished with blue light (470 nm)

Initiator is camphorquinon, Phenylpropandion, Lucirin

Chemically cured composites

Iniciator is organic peroxide, accelerator amine

Curing

Chemically curing (activated) composites
Iniciator is organic peroxide, accelerator is tertiary amine

Light curing (activated) composites

Composite according to mode of curing

- Chemically curing (2 components)
- Light curing (1 component)
- Dual curing (2 components)

Initiation

- Photoiniciators absorb light and give energy to activtor that changes in free radicals
- For some iniciators is activator necessary for some not

- Camphorchinone
  CQ
- Phenylpropandion
  PPP
- Trimetylbenzoylphosphinoxid TPO

Composites acc. to size of filler

Macrofiller (macrofilled) composites

1 – 10 μm

Microfiller (microfilled) composites

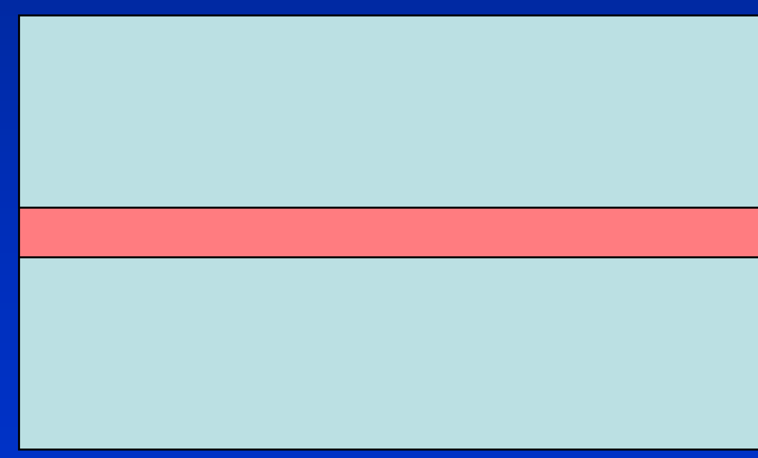
0,01 – 0,04 μm

Hybrid composites (contain macro and microfiller, nano filler)

Adhesion

Adhesion

- Adhesive
- Adherend



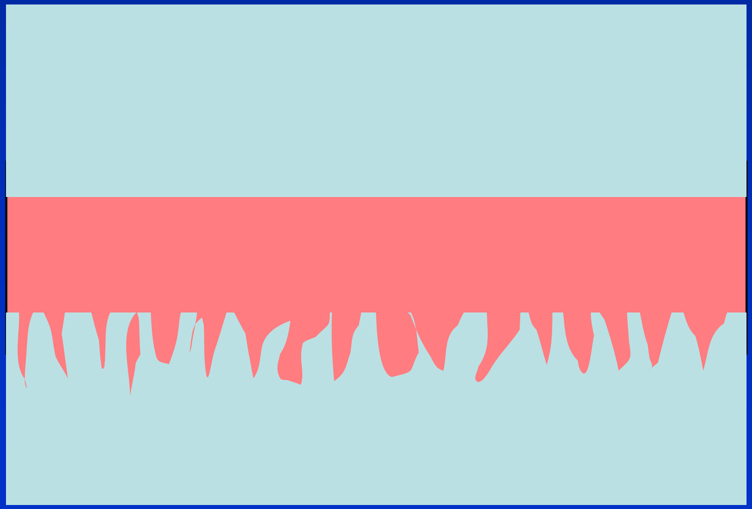
Adhesion

- **Mechanic**
- **Specific**

Adhesion

Mechanic

Irregulartiies of the surface



Adhesion

- **Specific**

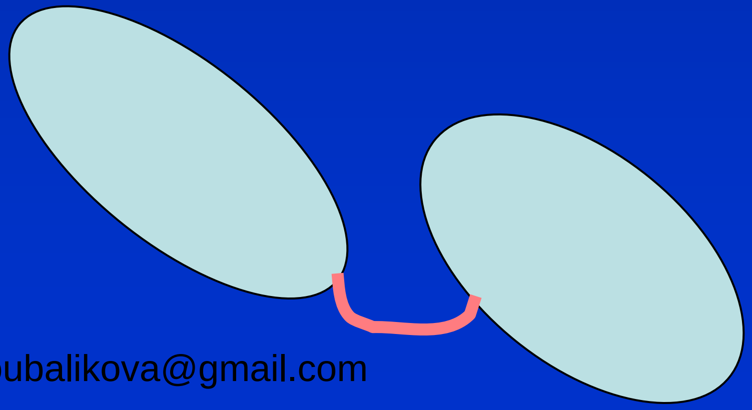
Physical

Chemical

Adhesion

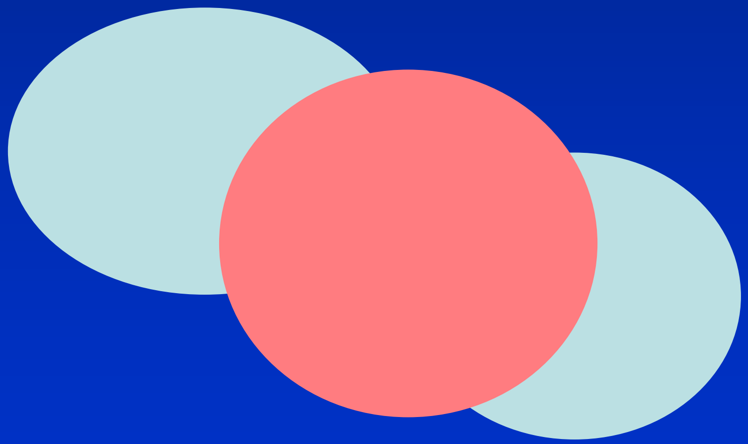
- **Specific**

Physical – intermolecular forces - Van der Waals, hydrogenium bridges



Adhesion

- **Specific**

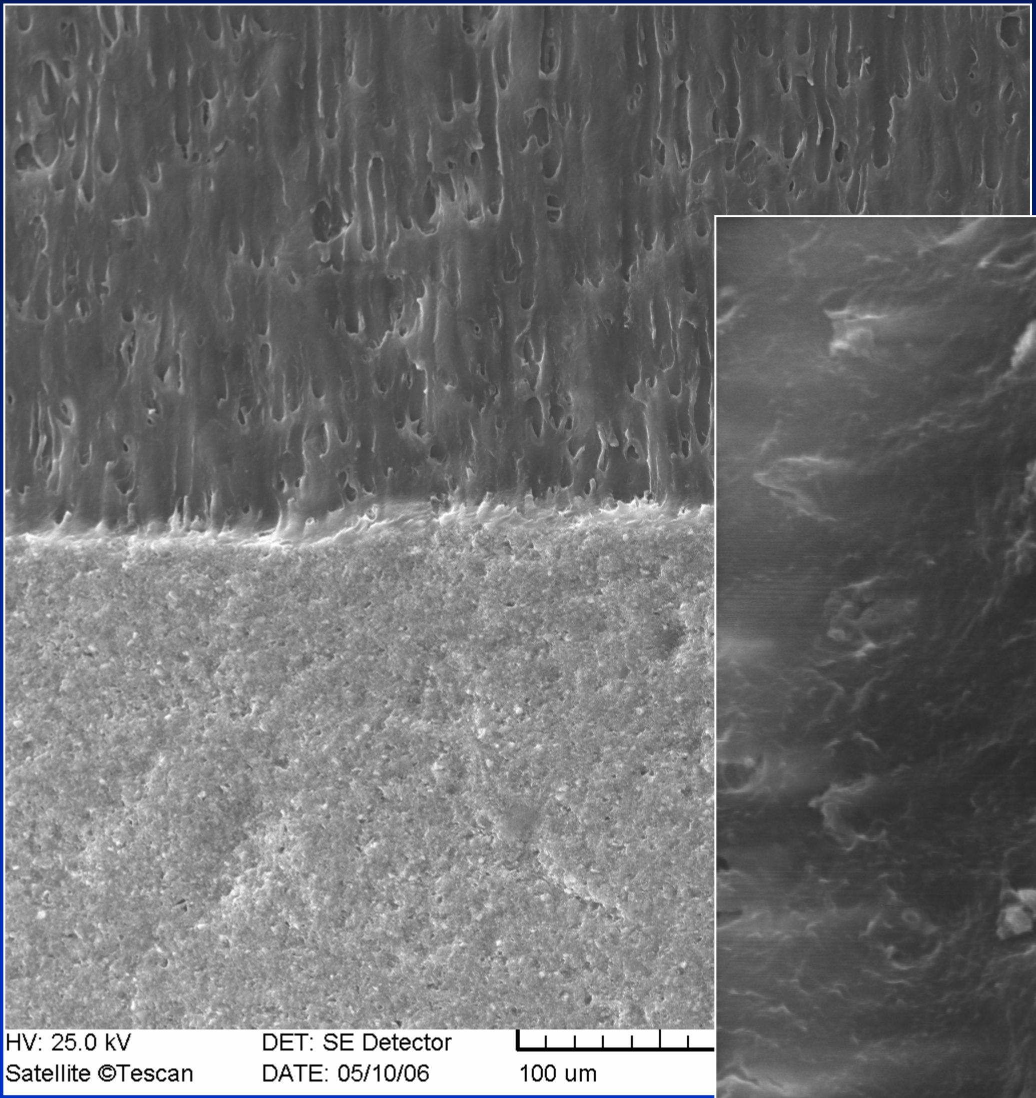


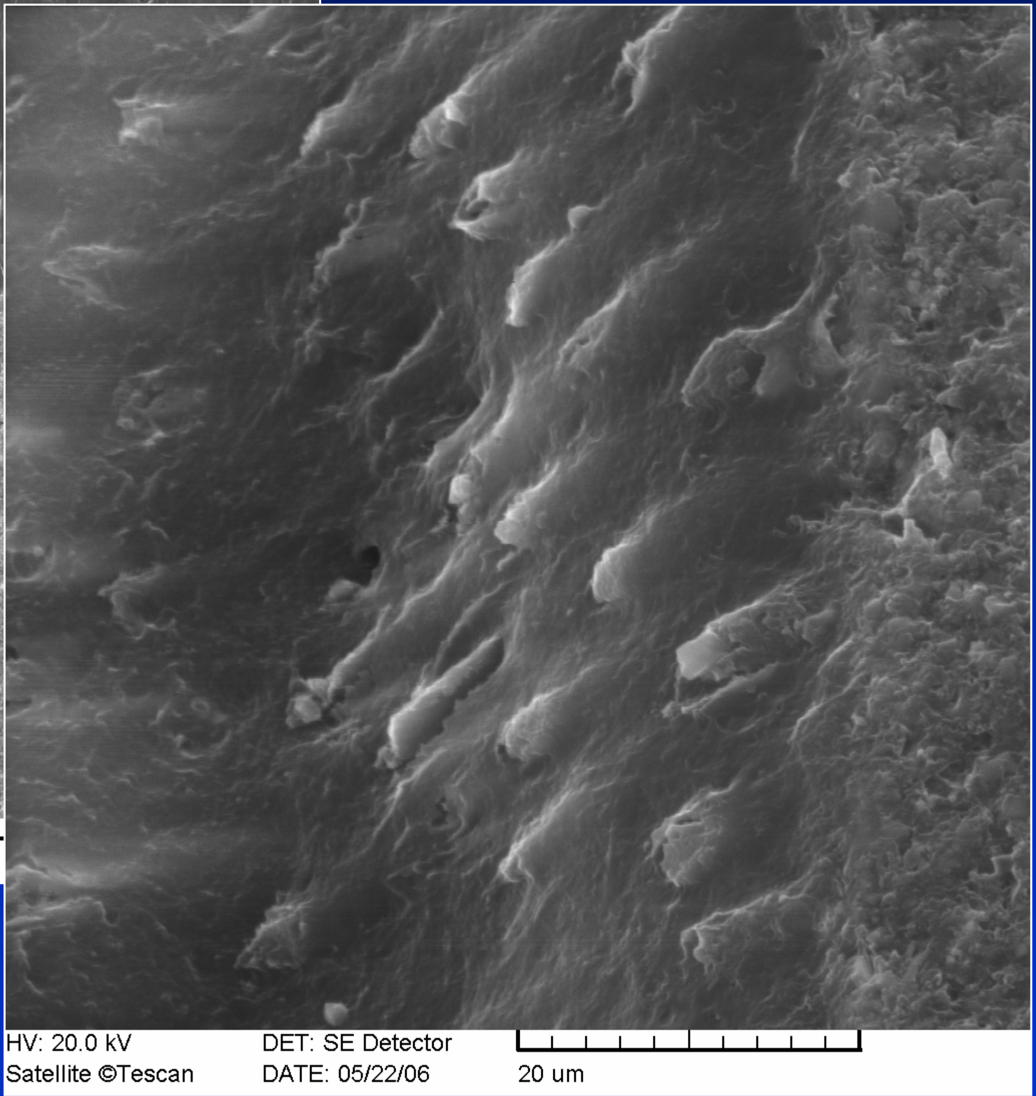
Adhesion

- **Sandblasting**
- **Electrolytic**
- **Silanization**
- **Plazma coating**
- **Silanization**

Adhesive preparation of surfaces

- Creates irregularities
- Increases surface energy


HV: 25.0 kV
DET: SE Detector
100 um
Satellite ©Tescan
DATE: 05/10/06


HV: 20.0 kV
DET: SE Detector
20 um
Satellite ©Tescan
DATE: 05/22/06


Adhesion of dental materials

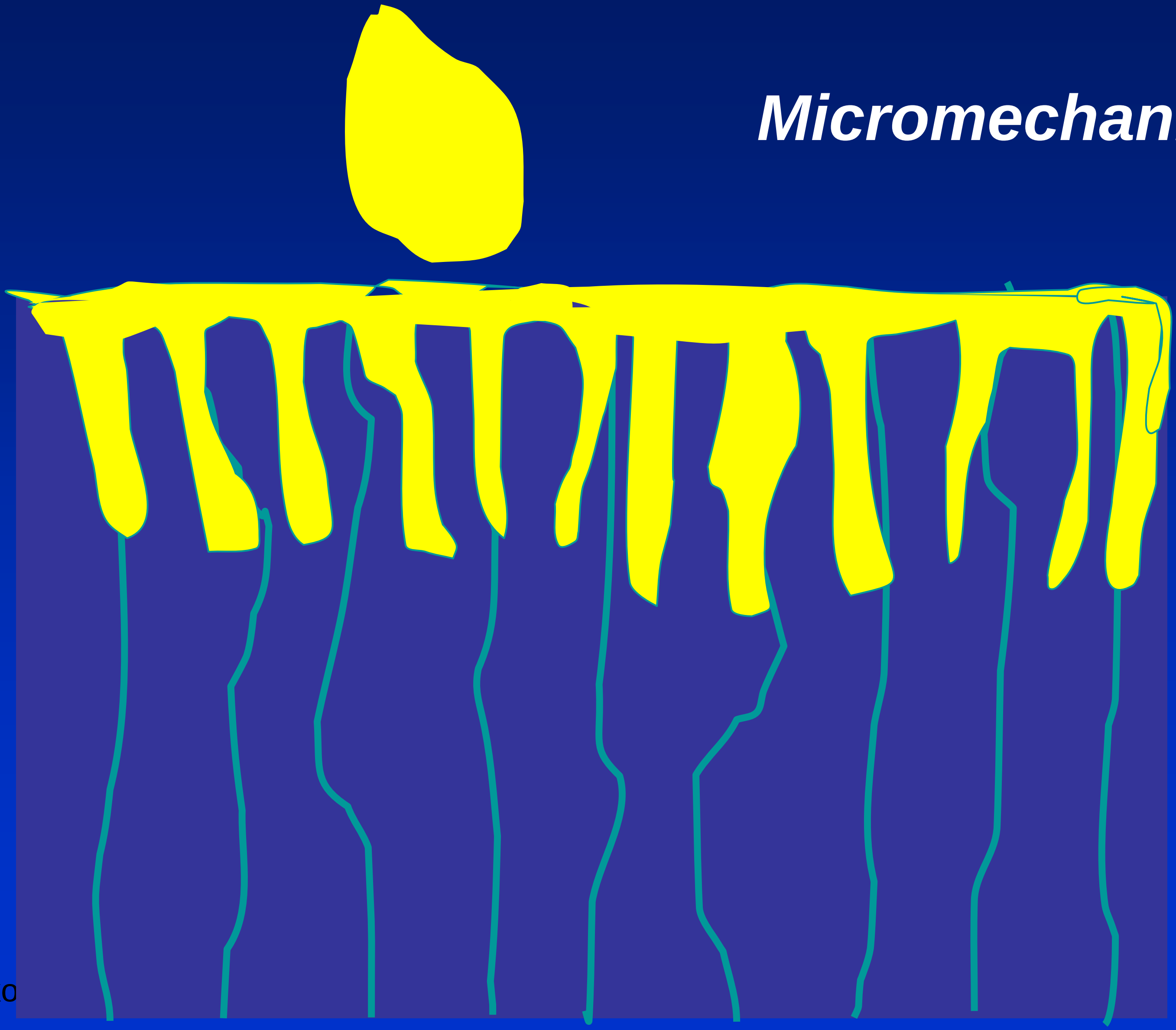
Composites - micromechanical

Adhesives – micromechanical, specific

Glassionomers - specific

Adhesion in enamel

Micromechanical



Iroubaliko

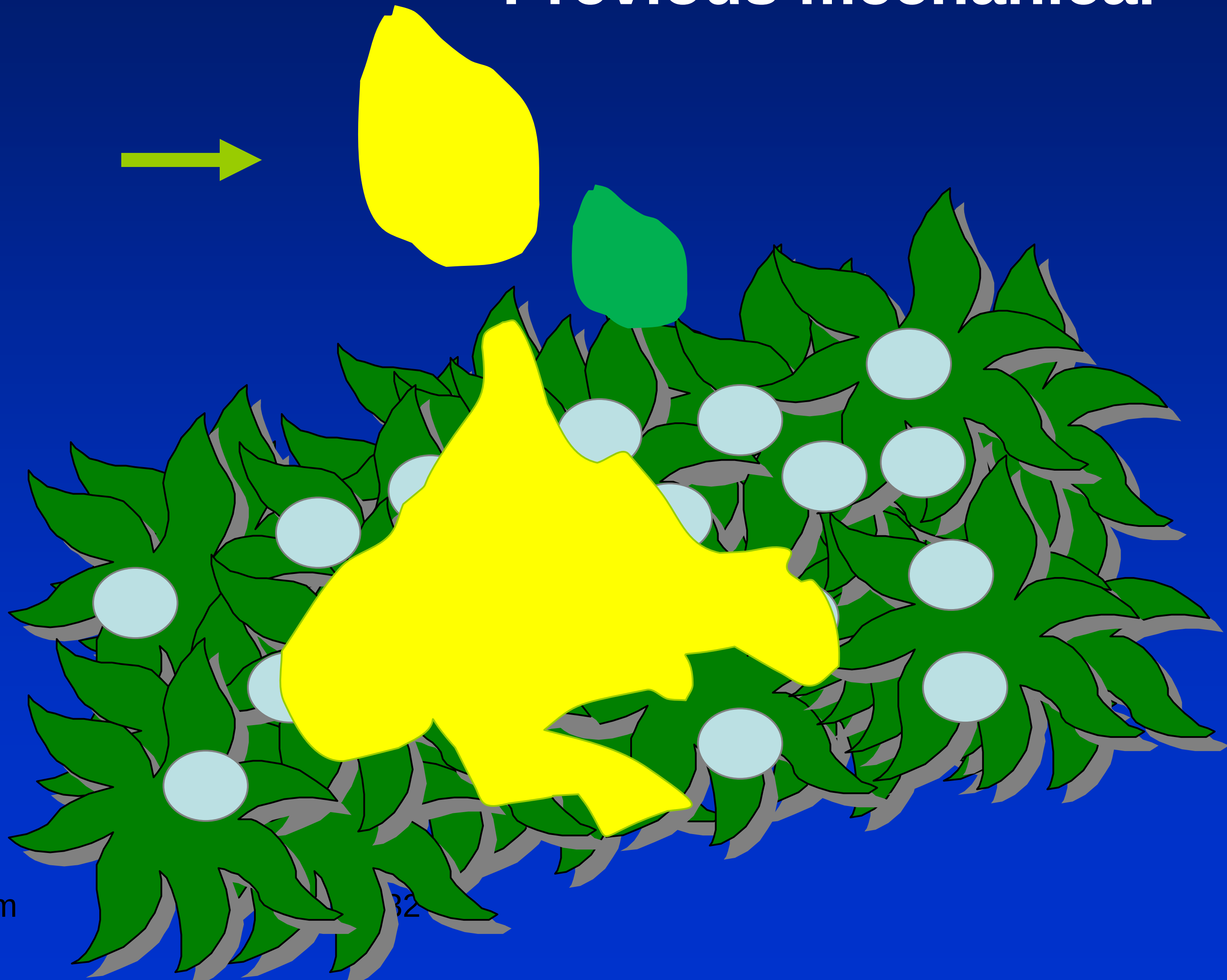
Adhesion to dentin

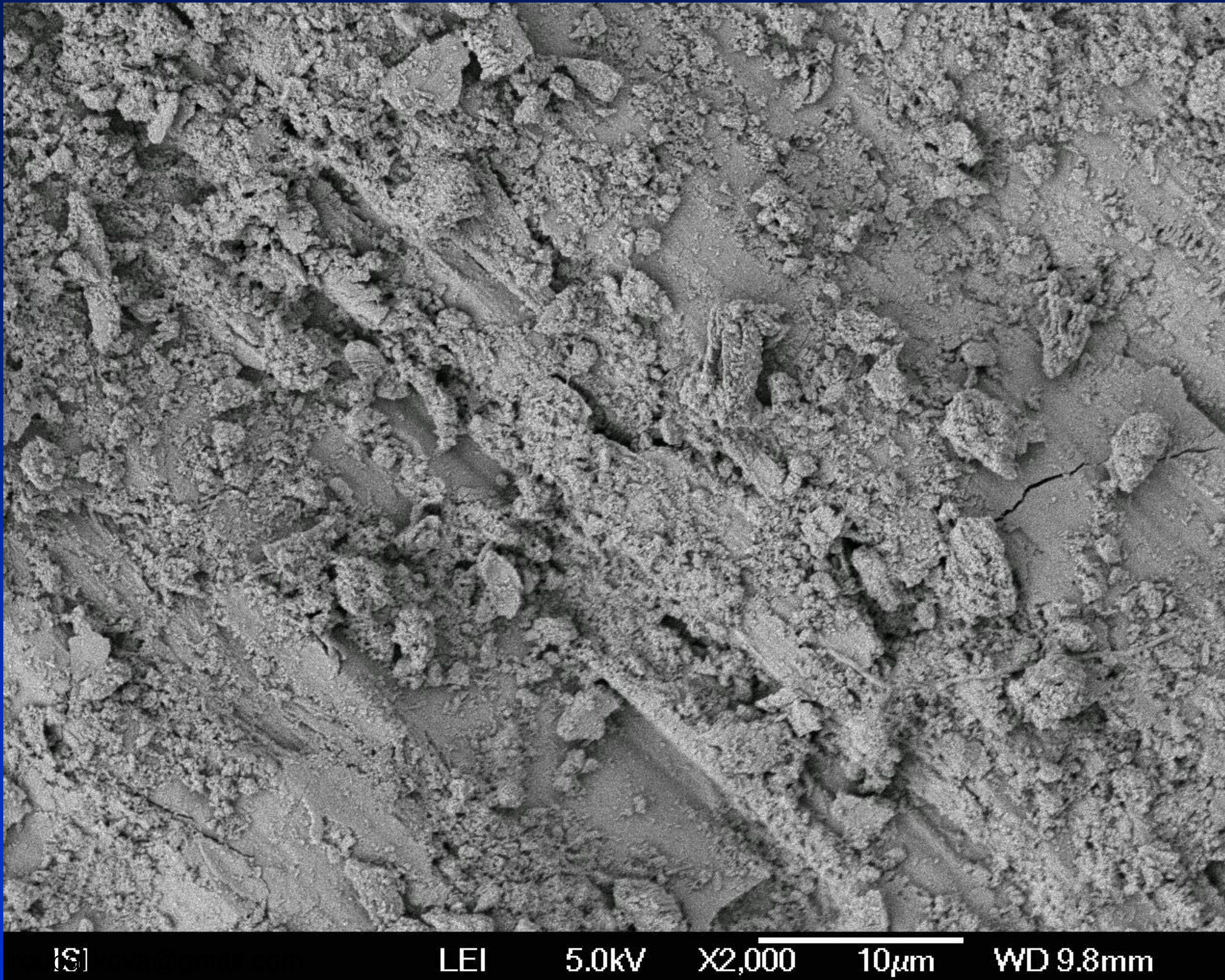
- More water and organic substances in comparison to water
- Tubular liquid
- Connection with the pulp chamber
- Smear layer
- Variety in composition

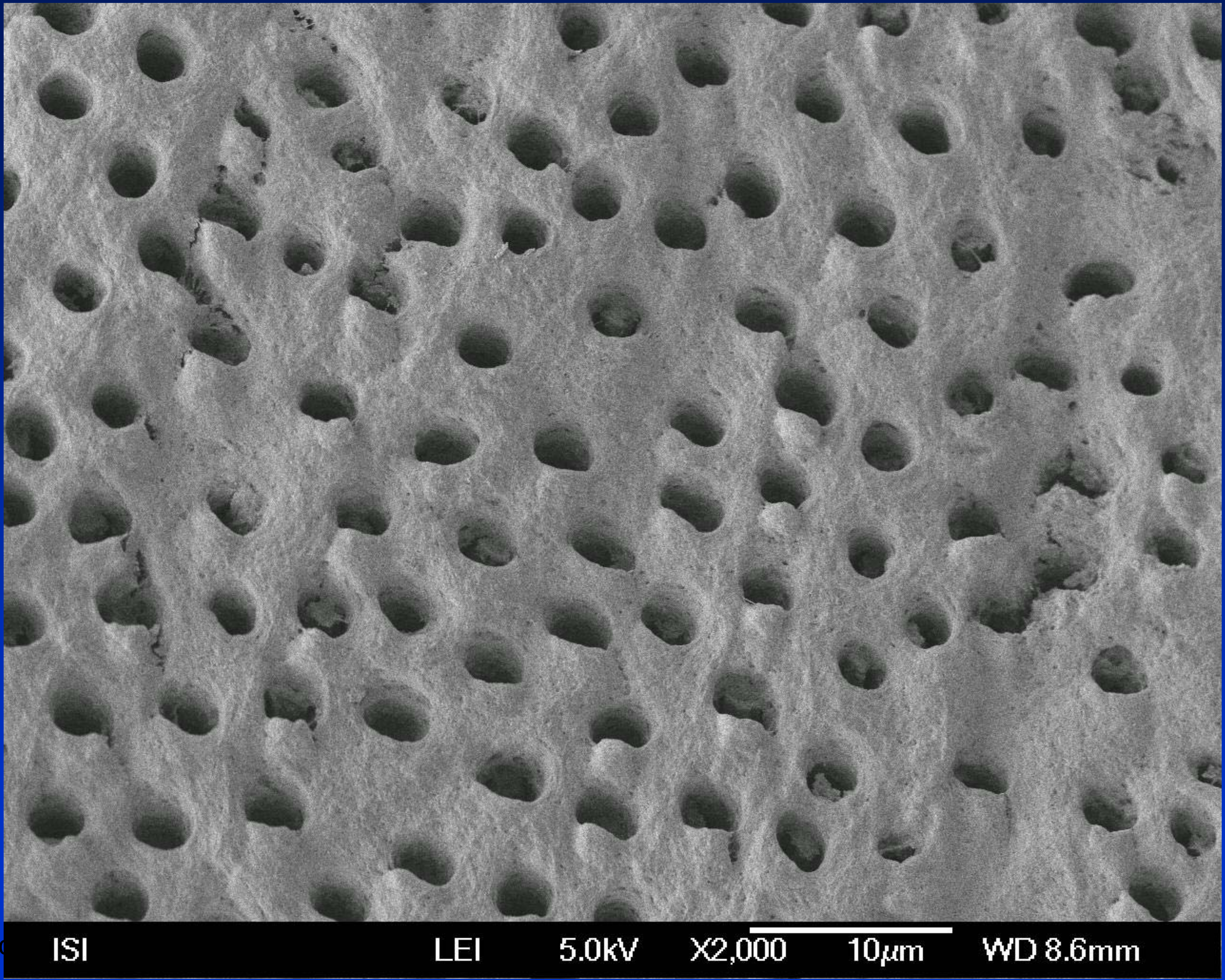
Adhesion to dentin

Previous mechanical

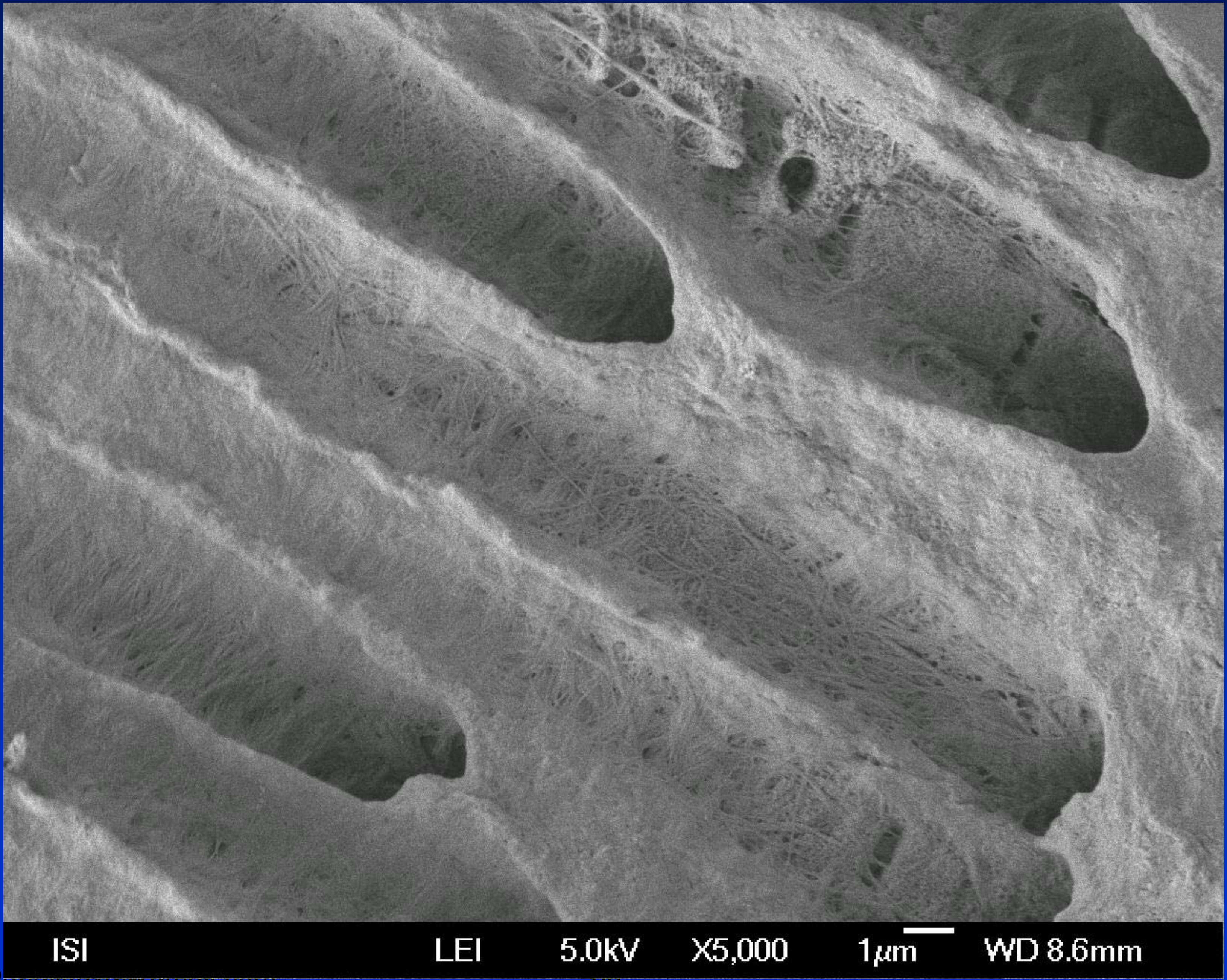
Adhesive system




LEI
5.0kV
X2,000
10μm
WD 9.8mm



Ir


ISI
LEI
5.0kV
X5,000
1μm
WD 8.6mm

Adhesives

- Acid etching technique
- Selfetching adhesive systems

Adhesives

- Acid etching technique

Etching

Washing

Priming Bonding

Adhesives

- Selfetching adhesive systems

Priming

Bonding

Adhesives

- Active and passive bonding

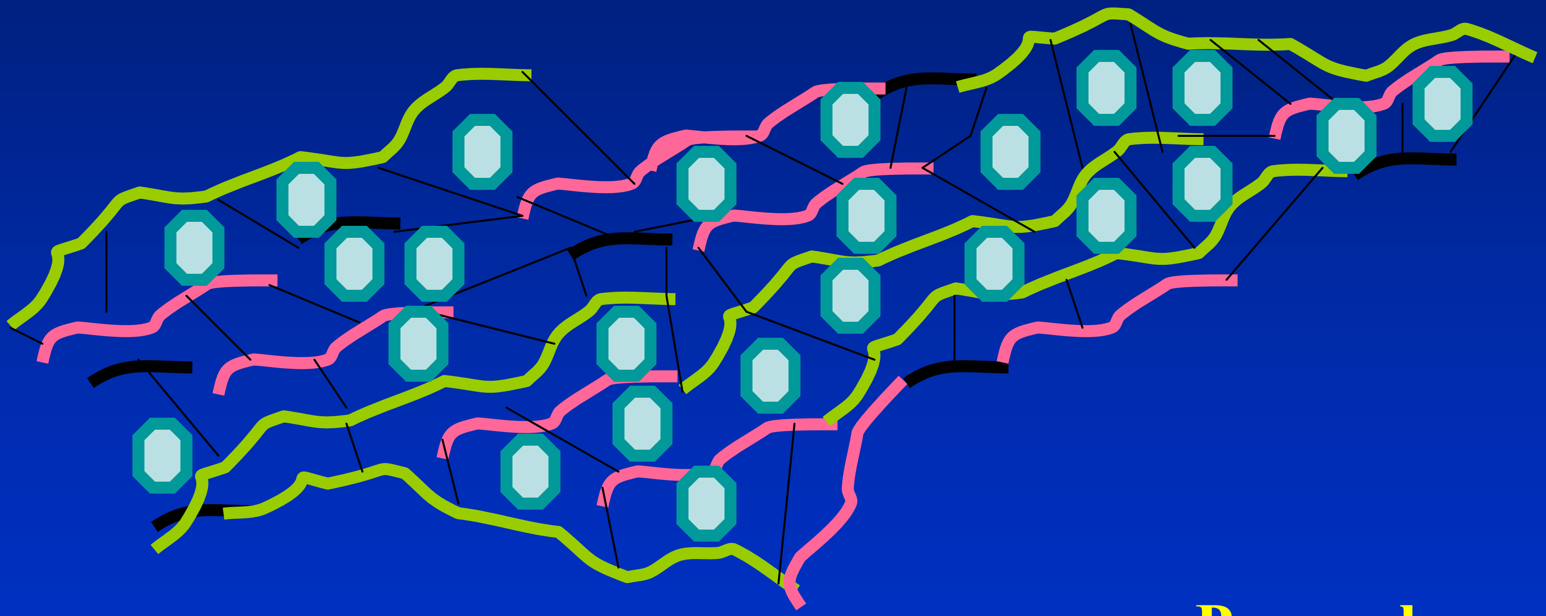
Active – rubbing with microbrush

Passive – without any rubbing

Polymerization

Polymerization strain and stress

Polymer network



Pre –gel

Gel

Post -gel

Chellenges of direct composite restorations

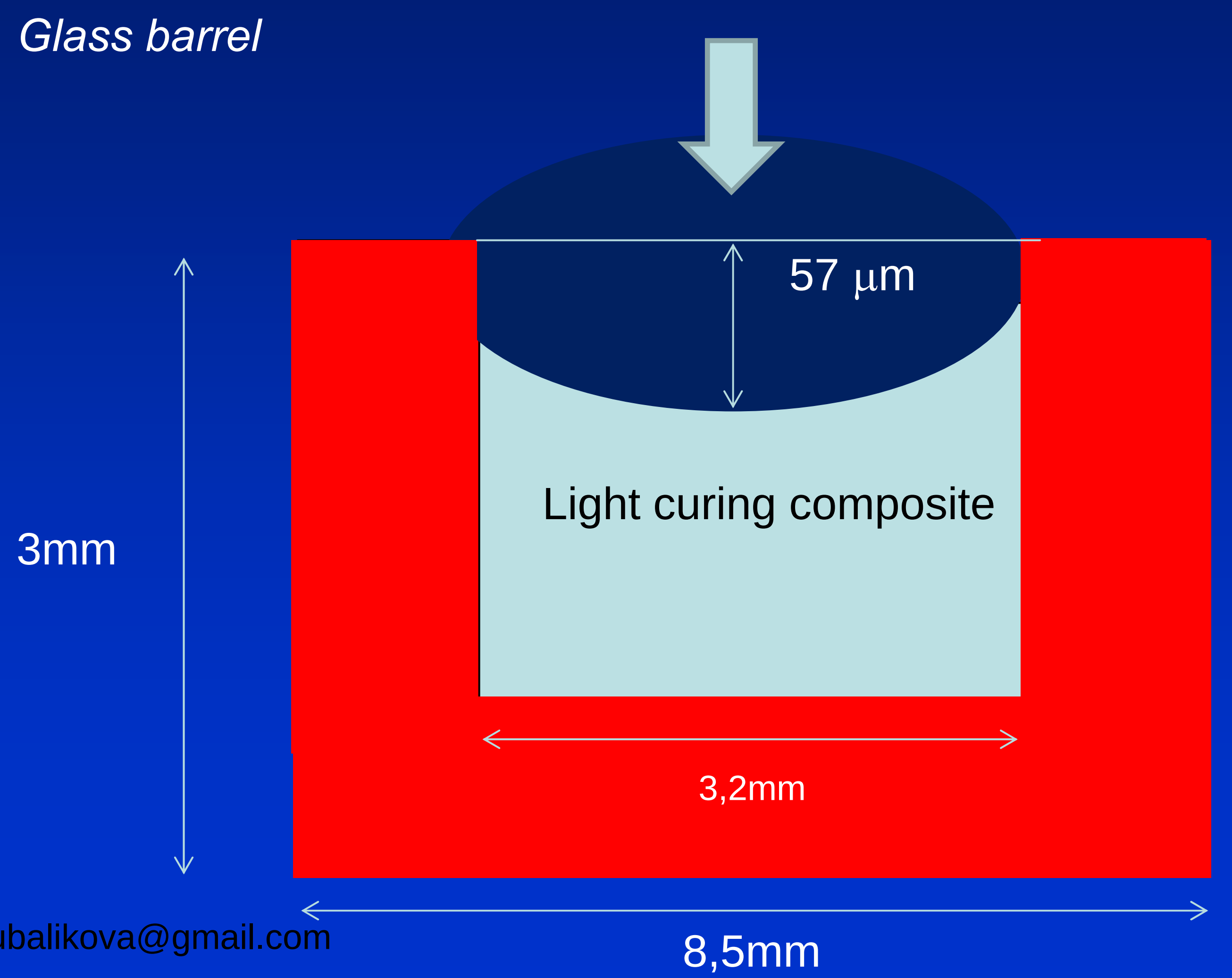
- Polymerization strain and polymerization stress

GEL POINT

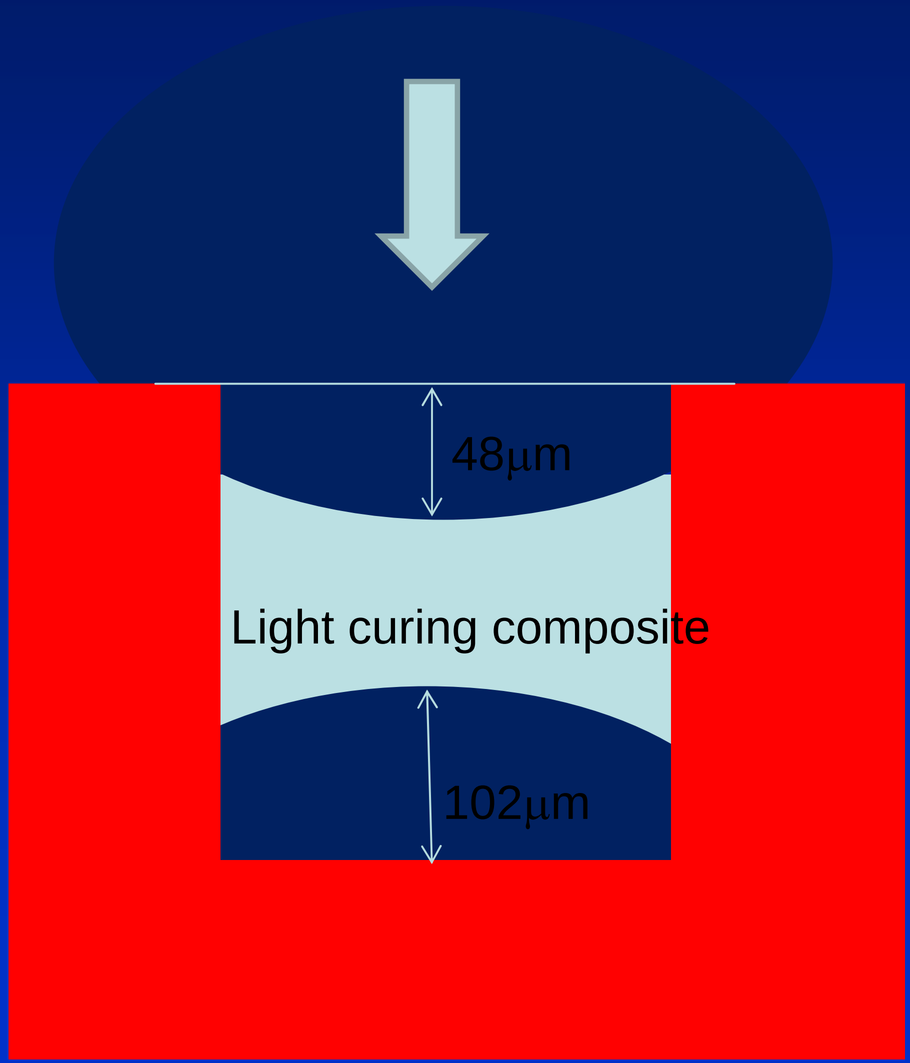
Pregel phase

Postgel phase

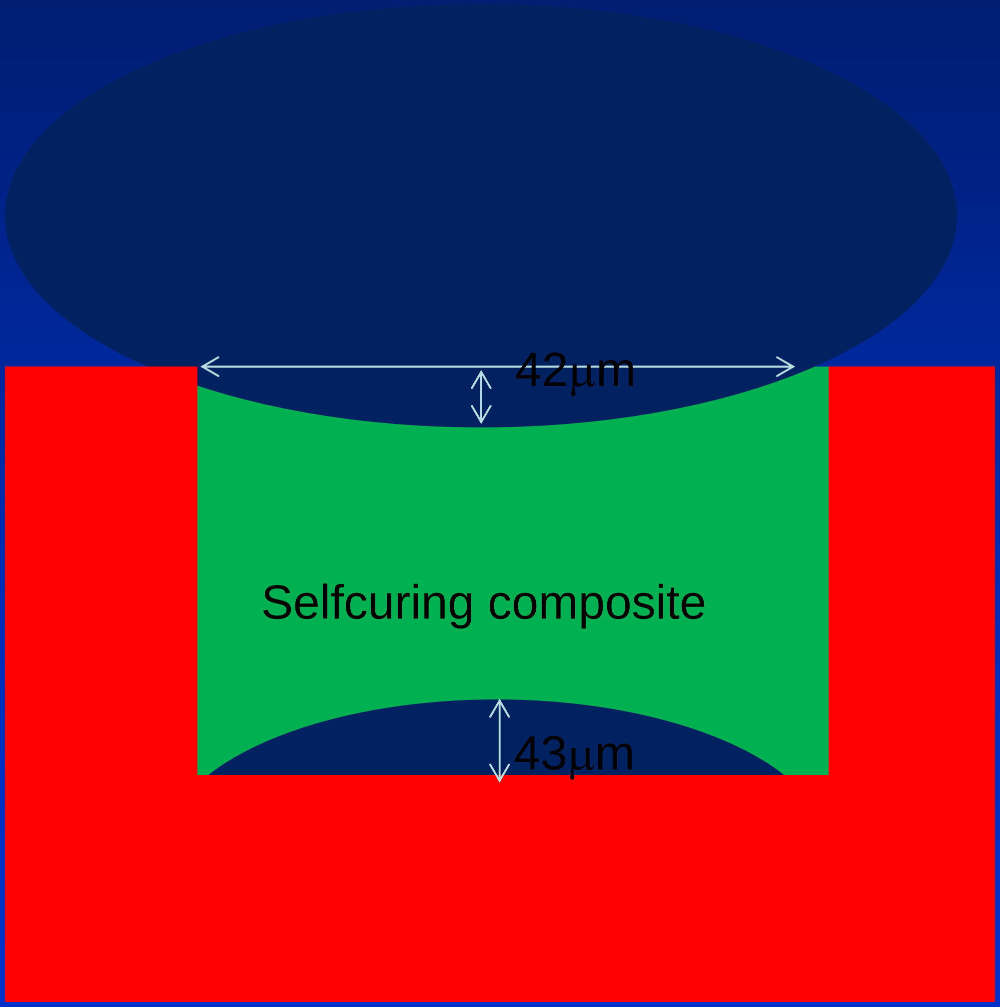
Byung, Suh
Principles of adhesion dentistry
2013



lroubalikova@gmail.com



lroubalikova@gmail.com


42µm
Selfcuring composite
43µm

- In selfcuring composites is the pregel phase longer.
- In light curing composites is pregel phase shorter.

Polymerization strain and stress sre influenced by

Material

Geometry of the cavity

Mode of application

Mode of polymerization

Polymerization strain and stress are influenced by

<u>Material</u>

Geometry of the cavity

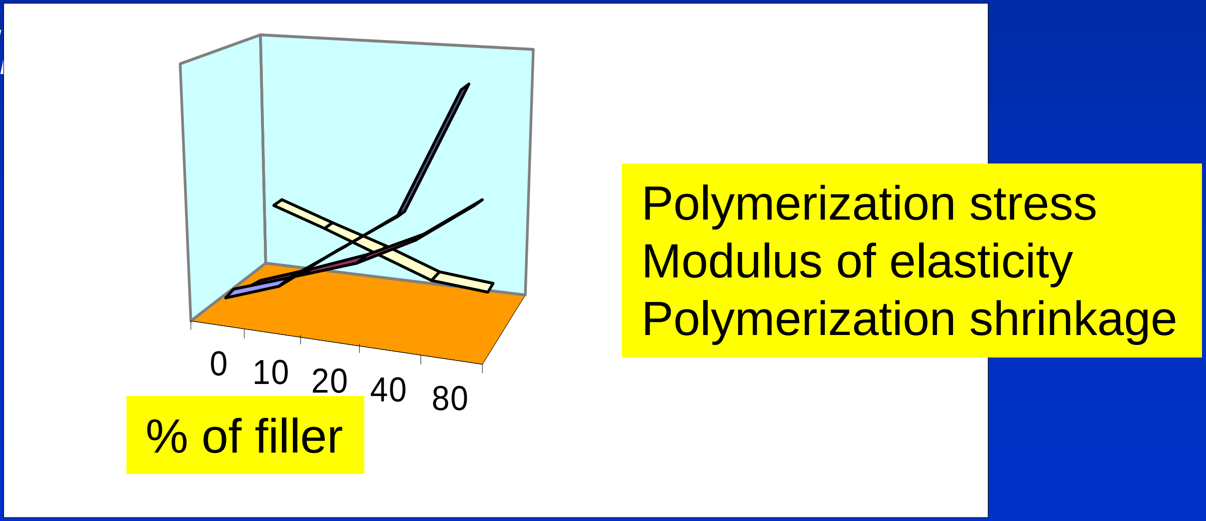
Mode of application

Mode of polymerization

Material

$\sigma = \varepsilon \, . \, E$

Hihg content of filler – low polymerization shrinkage, high polymerization strain and st



Polymerization strain and stress sre influenced by

Material

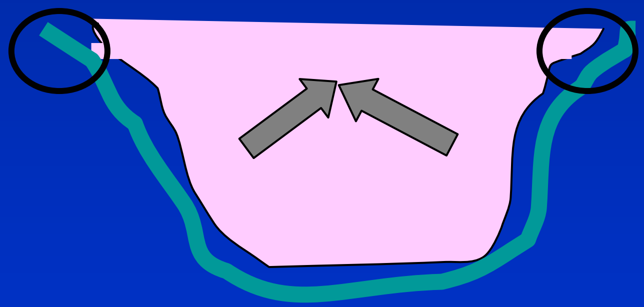
<u>Geometry of the cavity</u>

Mode of application

Mode of polymerization

C-faktor

Configuration factor
Ratio of bonded to non bonded area

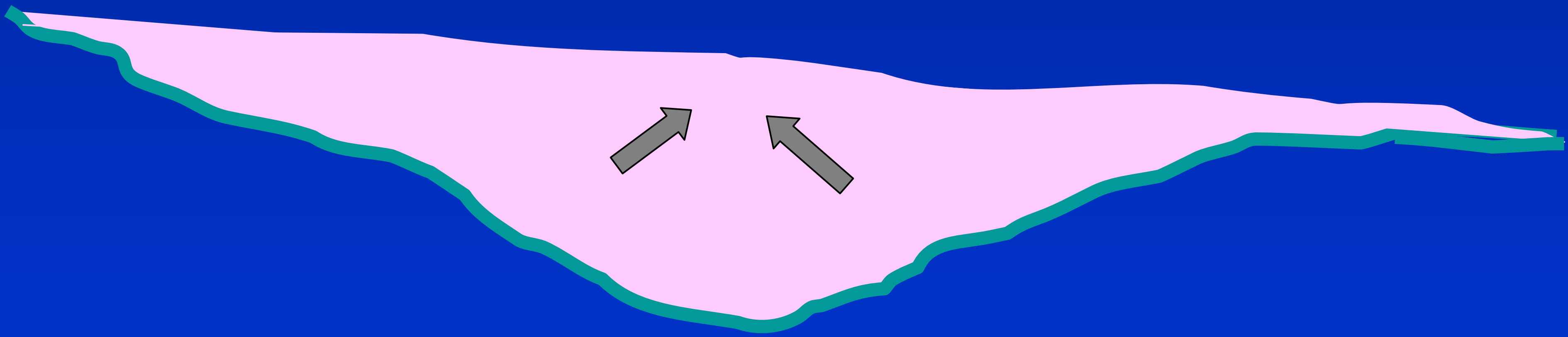


1:1 and less is good

C-faktor

= konfigurační faktor

Plocha adheze / volný povrch výplně

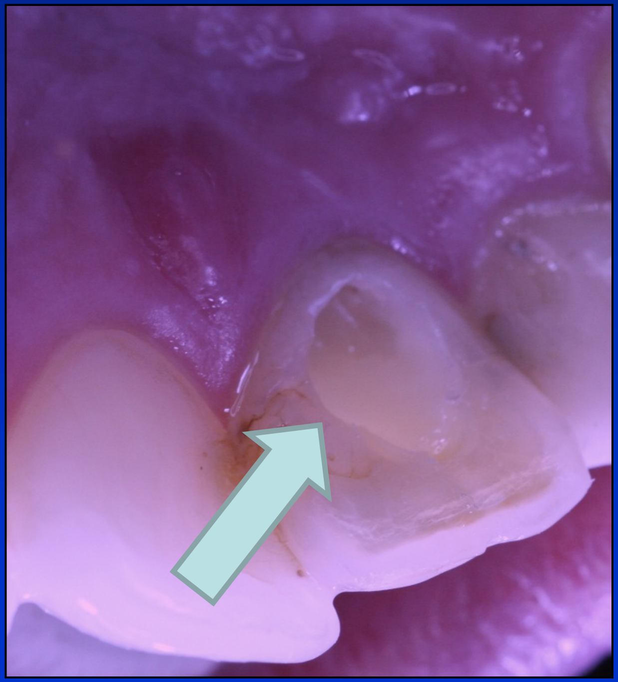


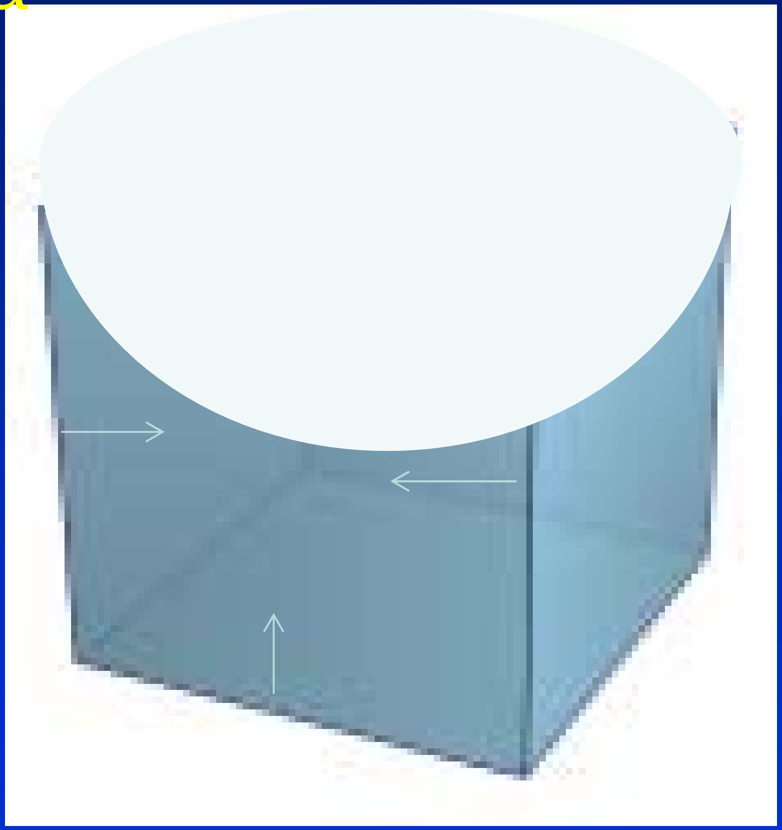
1/1 a méně je optimální

C- faktor

Sum of bonded area

Sumanot bonded area





Polymerization strain and stress sre influenced by

Material

Geometry of the cavity

Mode of application

Mode of polymerization

First layer must be thin

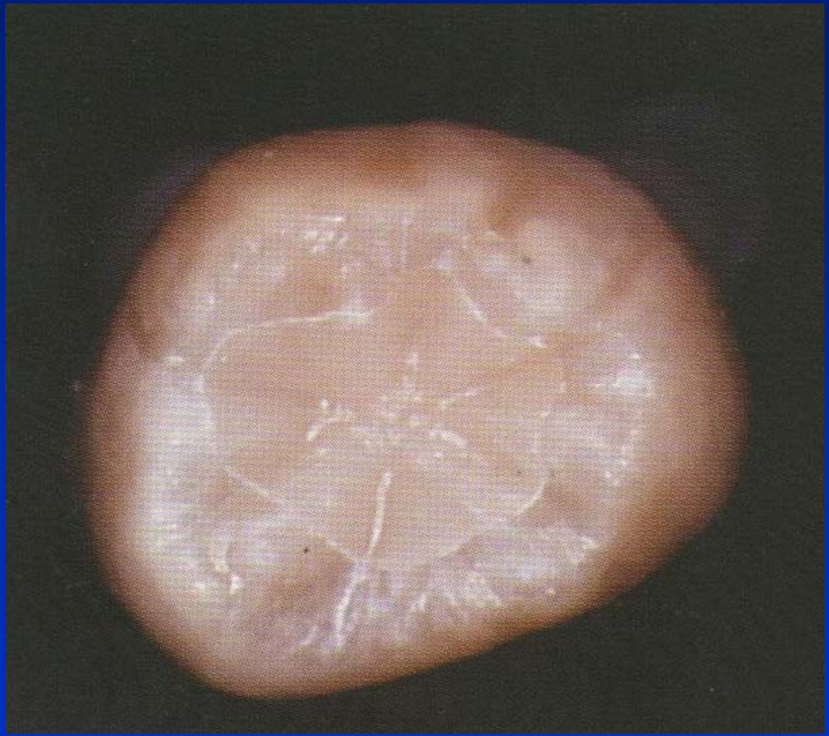
Shrinkage of the thin layer – minimum of strain and stress – flowables are useful.

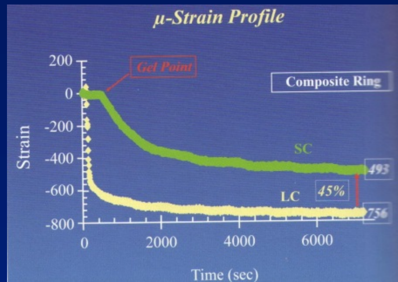
Elastic stress breaker (modulus of elasticity)

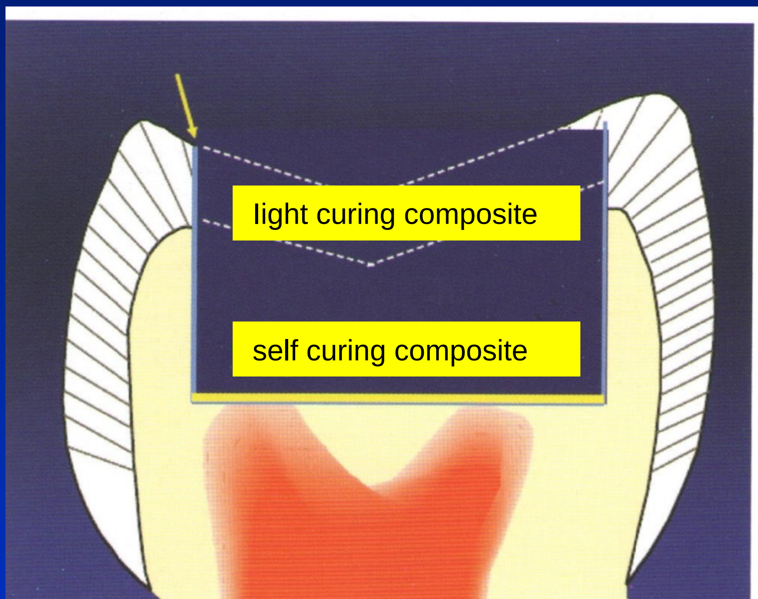
Risks of high C-factor

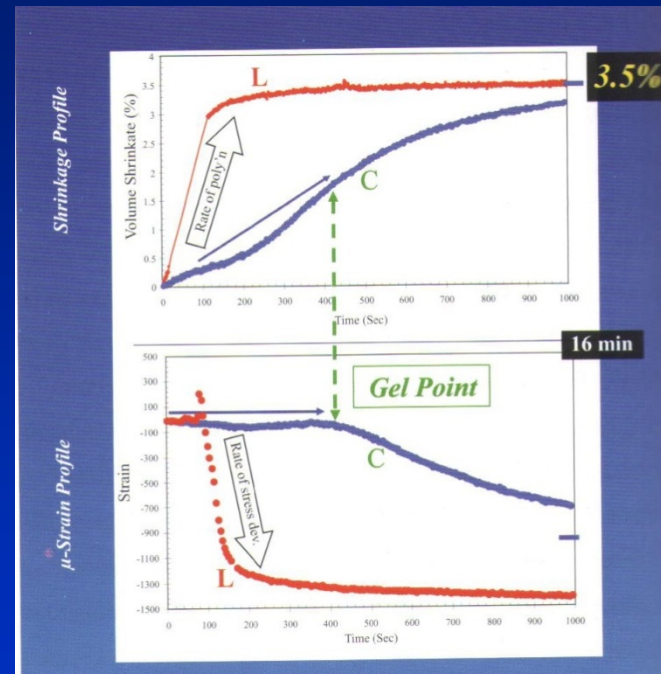
- Cracs in enamel
- Gaps in dentin

Sealing of the filling





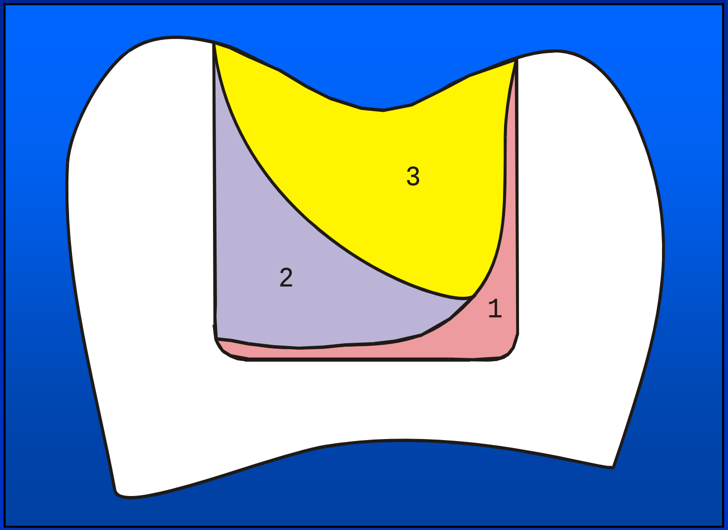




Combination of the materials makes a sense

Incremental technique

Layers with respect to the C factor of each place



Polymerization strain and stress sre influenced by

Material

Geometry of the cavity

Mode of application

<u>Mode of polymerization</u>

Prolongate of the gel phase

- Soft start ?

Polymerization units

Quartz-Tungsten-Halogen (QTH)

Plasma Arc (PAC)

Light Emitting Diode (LED)

Photonitiator system

- Photosenzitores are moleculs that absorb light and transfer the excitation energy to a coinitiator molecule that will become a free radical

- Some photoinitiators require a co initiator (CQ requiers amine)

- Camphorquinone CQ

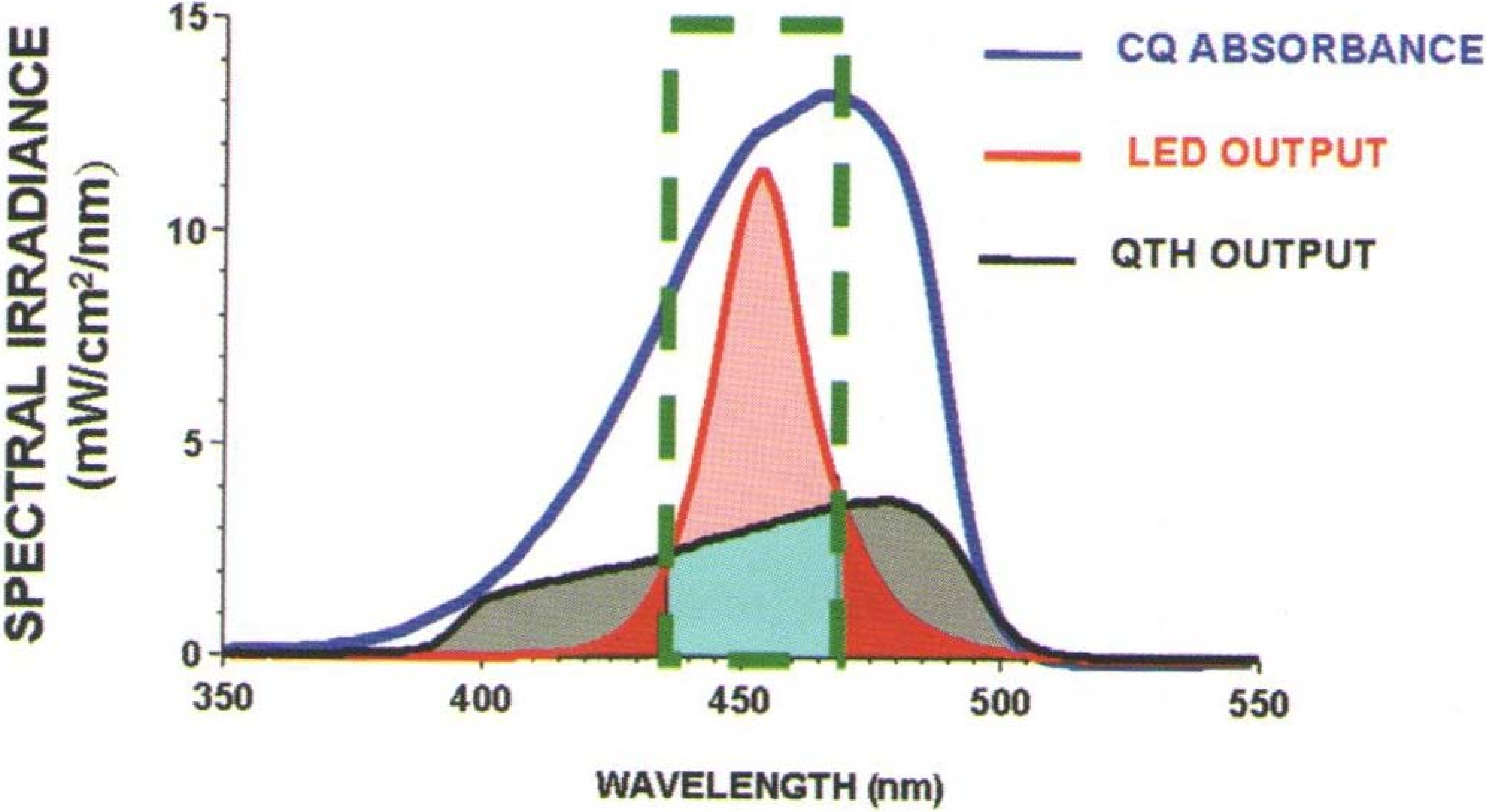
- Phenylpropandion PPP

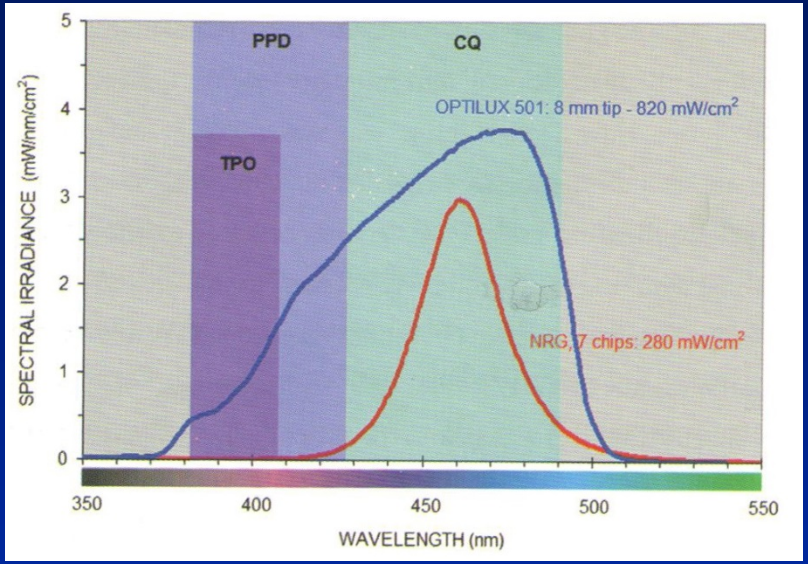
- Trimetylbenzoylphosphinoxid TPO

Absorption spectra

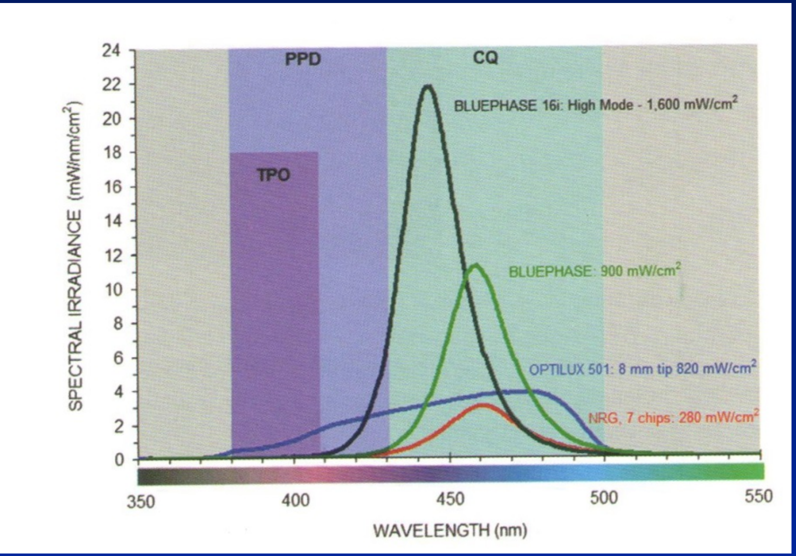
Photoinitiator	Absorption spectra (nm)	Maximum (nm)
CQ	440 - 500	470
PPD	380 – 430	400
TPO	350 - 410	380

ABSORPTIVE REGION THAN FROM QTH LIGHT

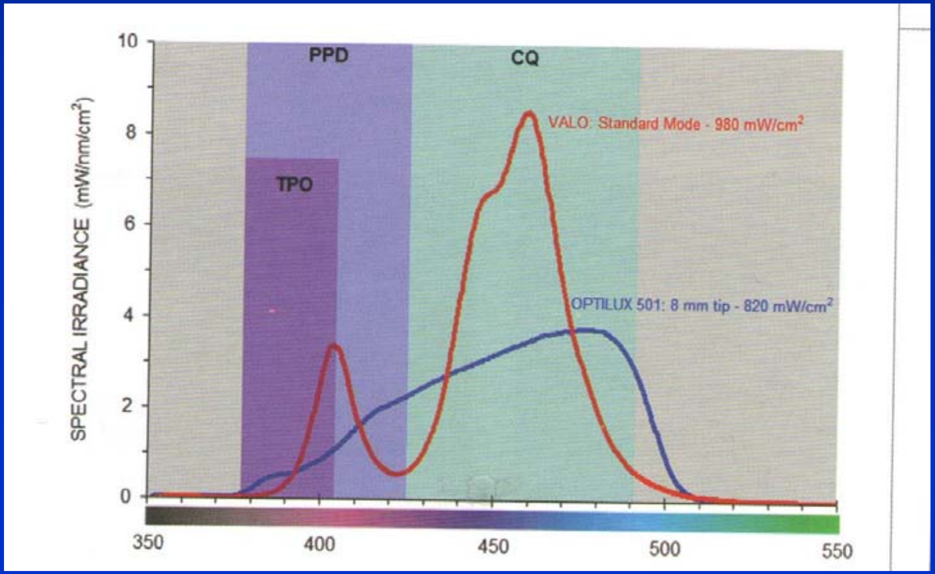




PPD
CQ
TPO
OPTILUX 501: 8 mm tip - 820 mW/cm2
NRG, 7 chips: 280 mW/cm2
SPECTRAL IRRADIANCE (mW/nm/cm2)
WAVELENGTH (nm)



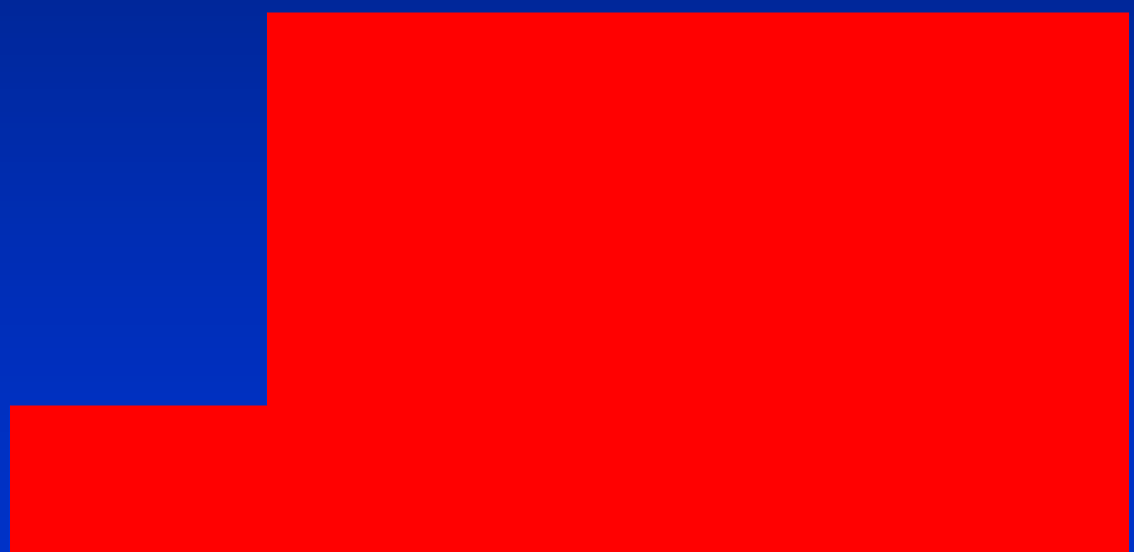
PPD
CQ
TPO
BLUEPHASE 16i: High Mode - 1,600 mW/cm2
BLUEPHASE: 900 mW/cm2
OPTILUX 501: 8 mm tip 820 mW/cm2
NRG, 7 chips: 280 mW/cm2
SPECTRAL IRRADIANCE (mW/nm/cm2)
WAVELENGTH (nm)



PPD
CQ
TPO
VALO: Standard Mode - 980 mW/cm2
OPTILUX 501: 8 mm tip - 820 mW/cm2
SPECTRAL IRRADIANCE (mW/nm/cm2)

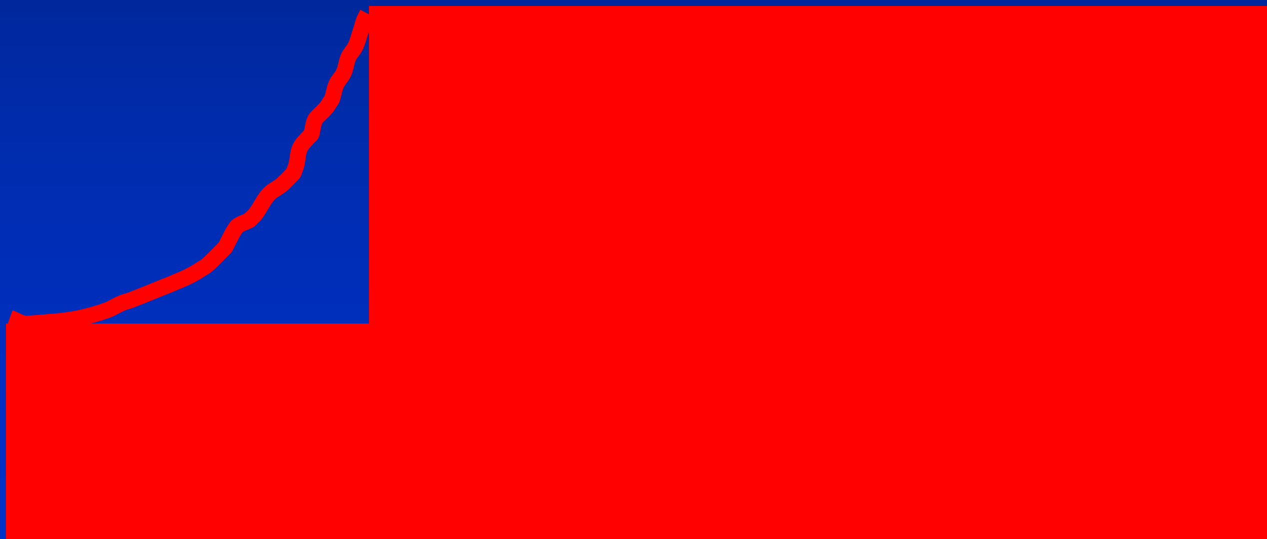
2 step polymerization

10 s cca 140 mW/cm^2 → *750 mW/cm^2 30 s*



Soft start

Continuos increasing to 750 mW/cm^2 during 10 s and polymerization 30s

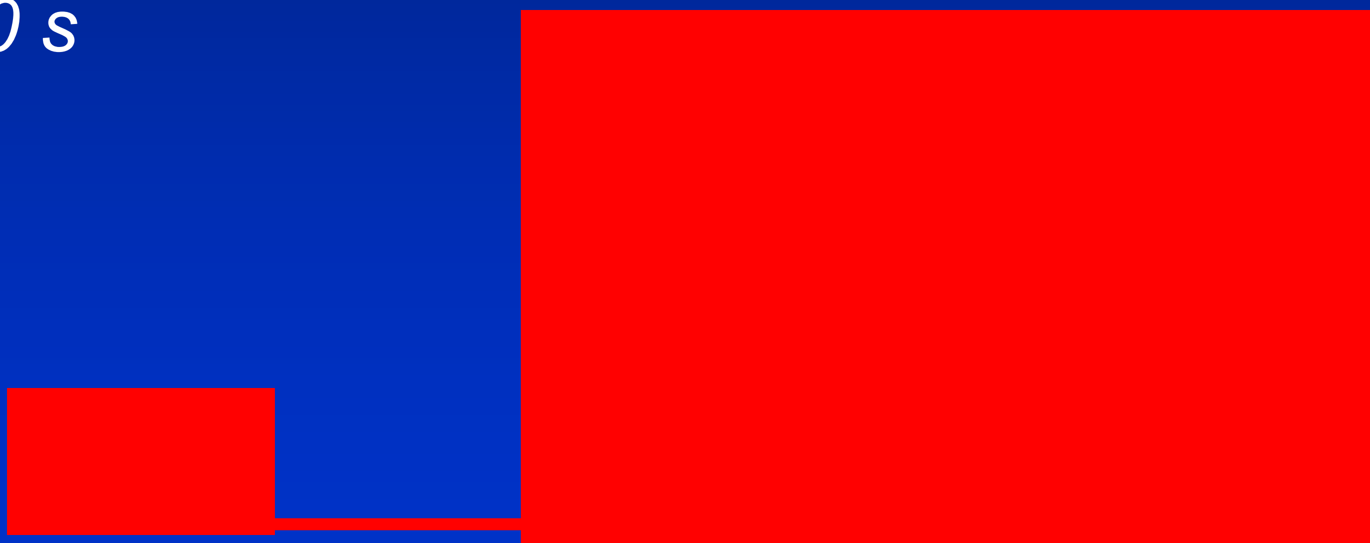


Continual polymerization

Min. 500 mW/cm^2 40 s

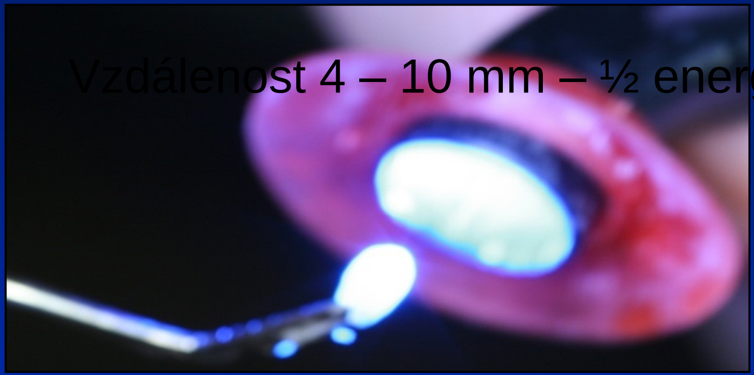
2 step polymerization with interruption

100 – 300 mW/cm^2 3-5 s, přerušoi na 3 min, pakpolymerovat 750 mW/cm^2 po 30 s



Energy and time of polymerization

- Recommended energy dose 12000 – 16000 mJ/cm²



$$\frac{12\,000\ \mathrm{mWs/cm^2}}{\mathrm{Intenzita\ mW/cm^2}} = \text{Time of polymerization in s}$$

Energy and time of polymerization

- Recommended energy dose 12000 – 16000 mJ/cm^2

$$\frac{12\,000\ mWs/cm^2}{Intenzita\ mW/cm^2} = \text{Time of polymerization in s}$$

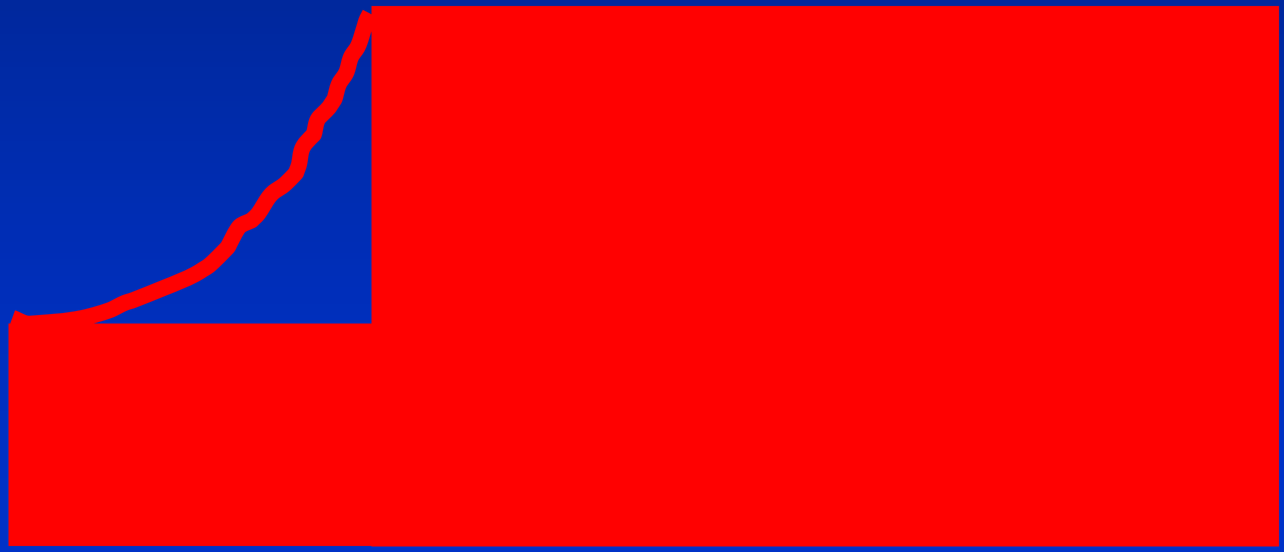
Distance 10 mm – ½ energie

2 step polymerization

10 s cca 140 mW/cm² → *750 mW/cm² 30 s*

Soft start

Continuos increasing to 750 mW/cm^2 during 10 s and polymerization 30s

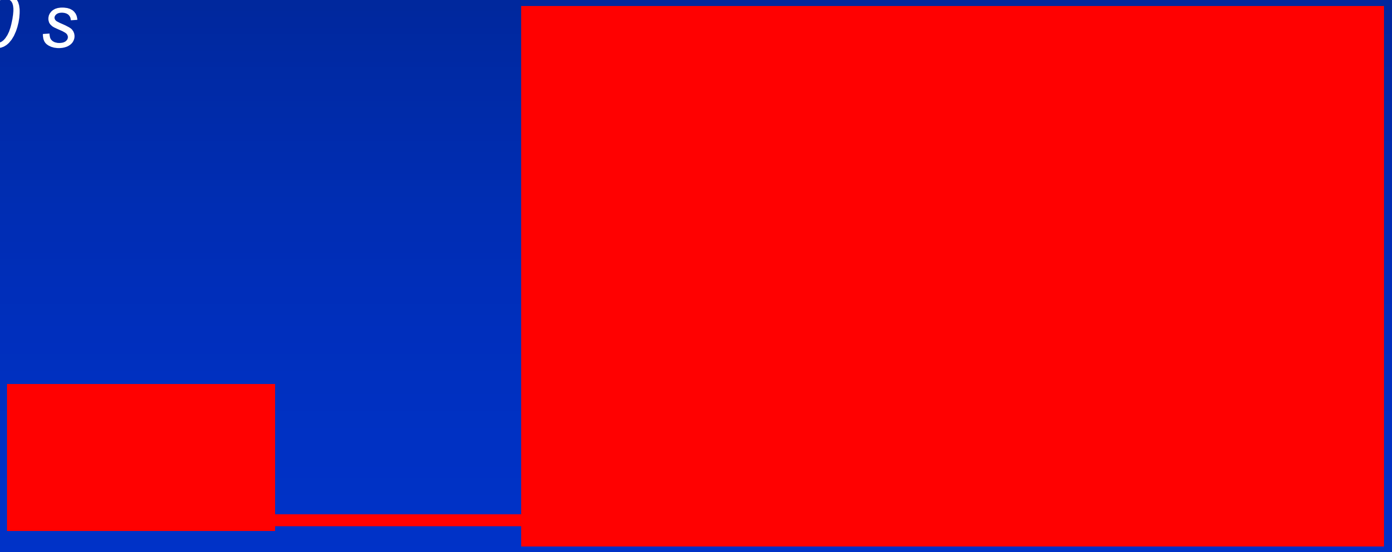


Continual polymerization

Min. 500 mW/cm^2 40 s

2 step polymerization with interruption

100 – 300 mW/cm^2 3-5 s, přerušoi na 3 min, pakpolymerovat 750 mW/cm^2 po 30 s



Marginal adaptation

- Placement of composite material
- Dry operating field
- Adhesive systems