

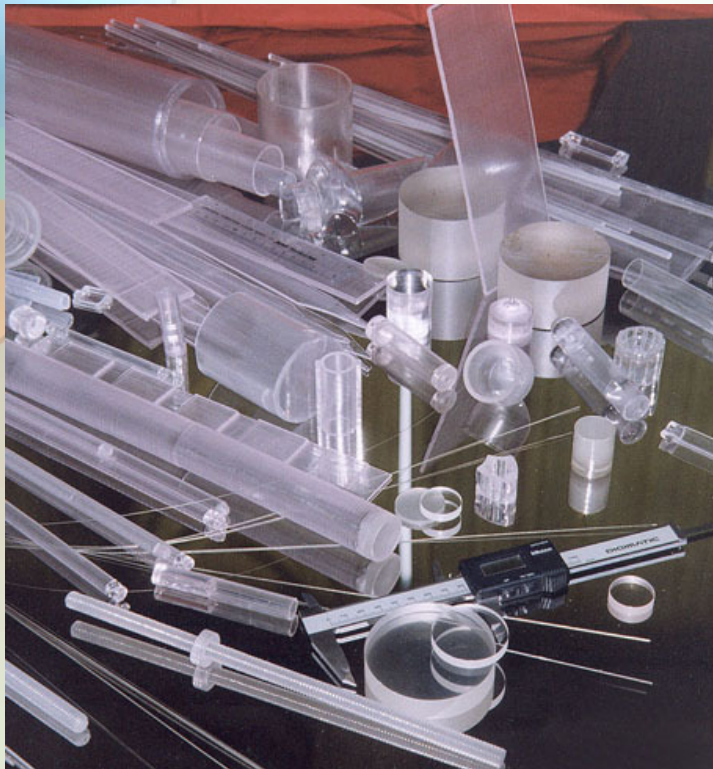
# Sapphire shaped crystals

Vladimir Kurlov



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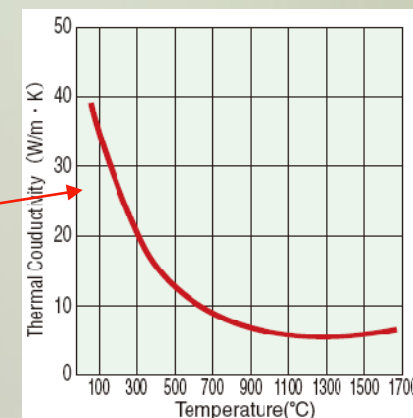
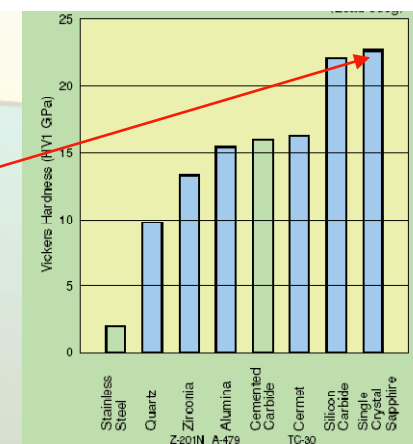
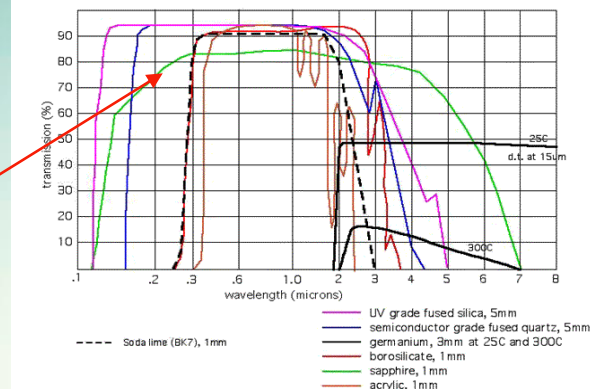
February 15, 2010

“Les Houches”



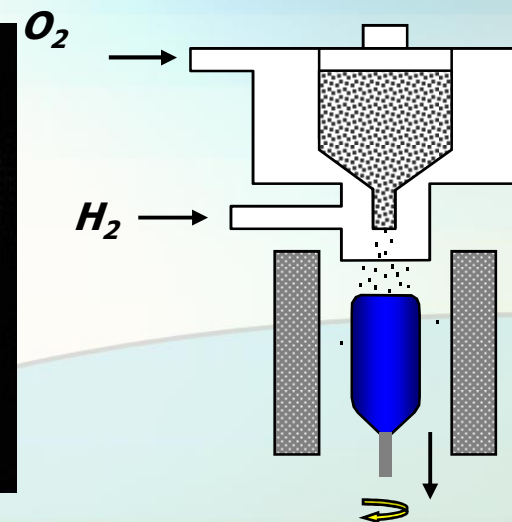
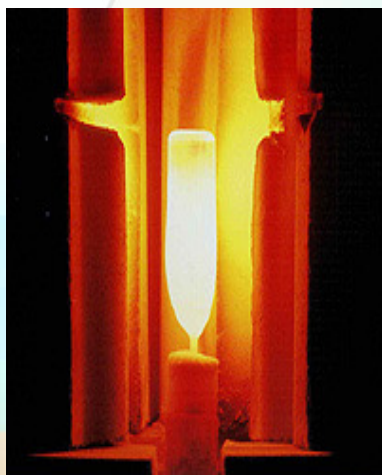
# Sapphire

- High melting point
- Broad transmission band spanning the UV, visible, and IR bands
- High tensile strength
- High chemical resistance
- Biocompatibility
- High hardness
- High specific heat
- Low thermal expansion
- High thermal shock resistance
- Very good thermal conductivity
- Low friction coefficient

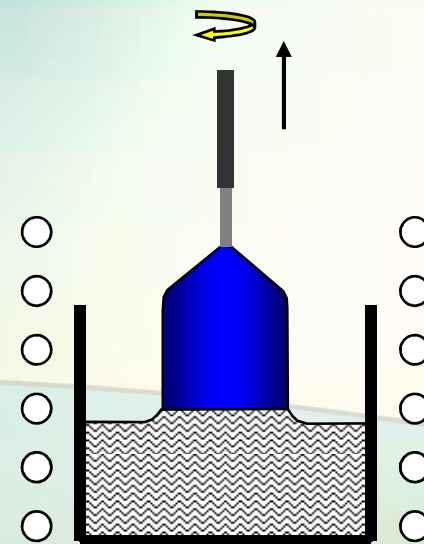




# Sapphire bulk crystals



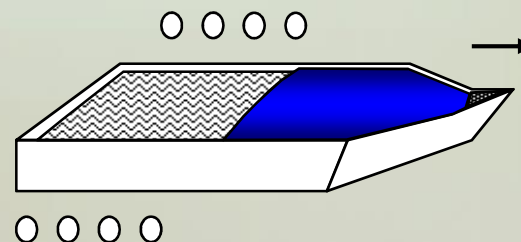
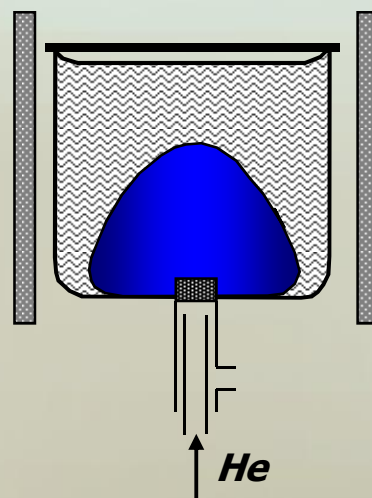
Verneuil



Czochralski



HEM

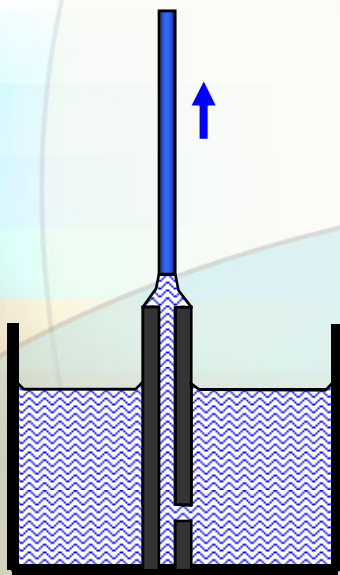


Bagdasarov

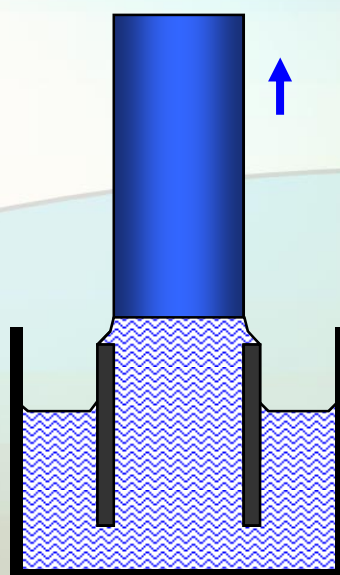


# Shaped crystal growth techniques

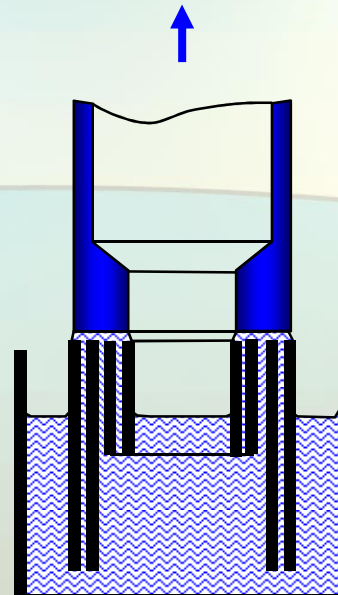
crystals are grown from a melt film formed on the top of a die



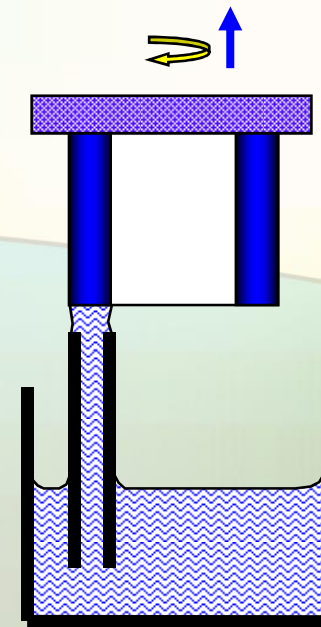
Edge-defined  
film-fed growth  
(EFG)



Noncapillary  
shaping  
technique (NCS)



Variable  
shaping  
technique (VST)

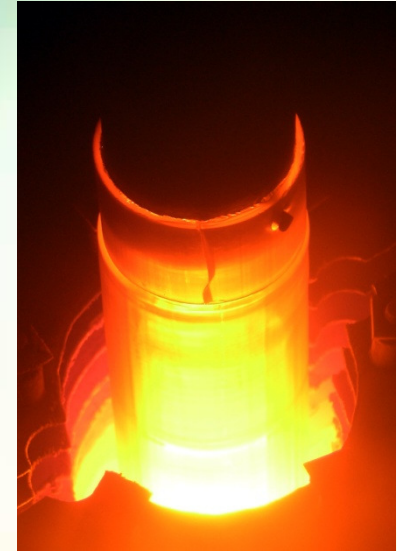


Growth from  
an element of  
shape (GES)

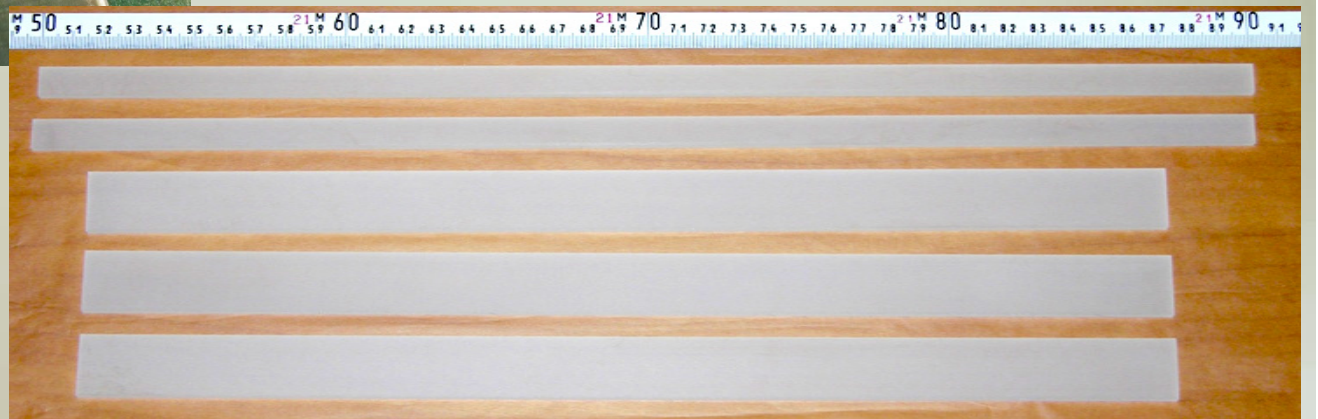
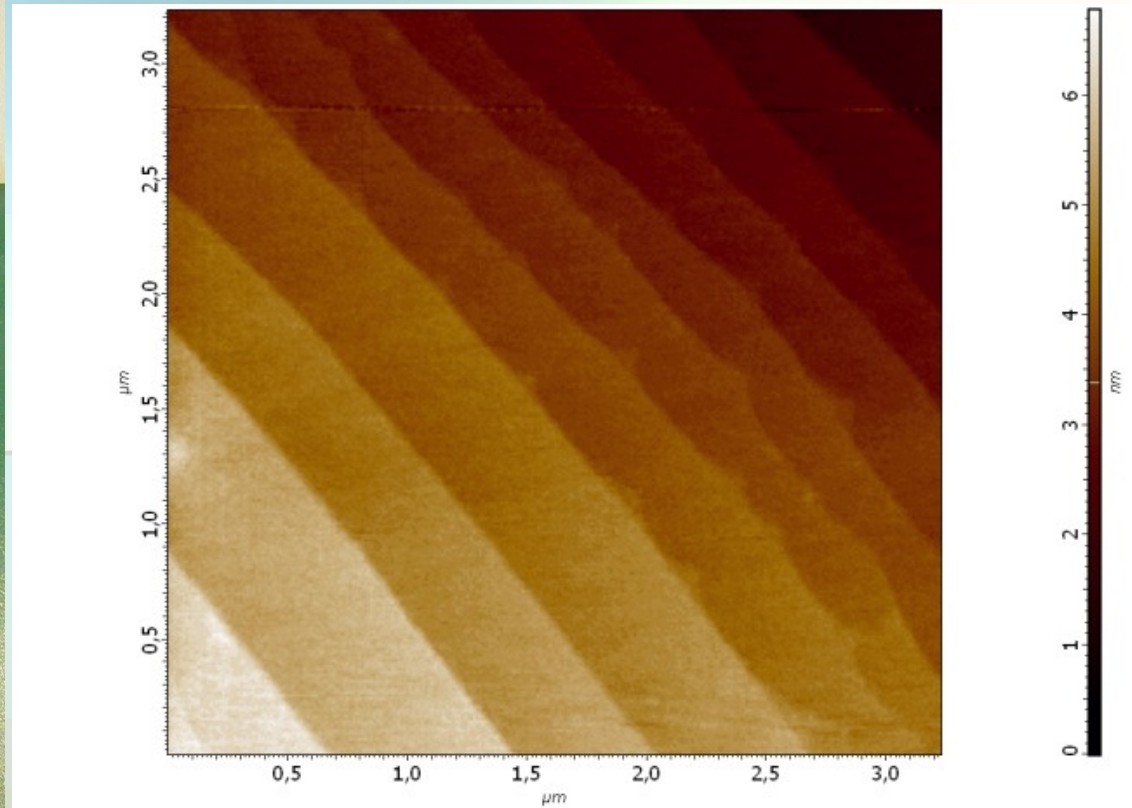
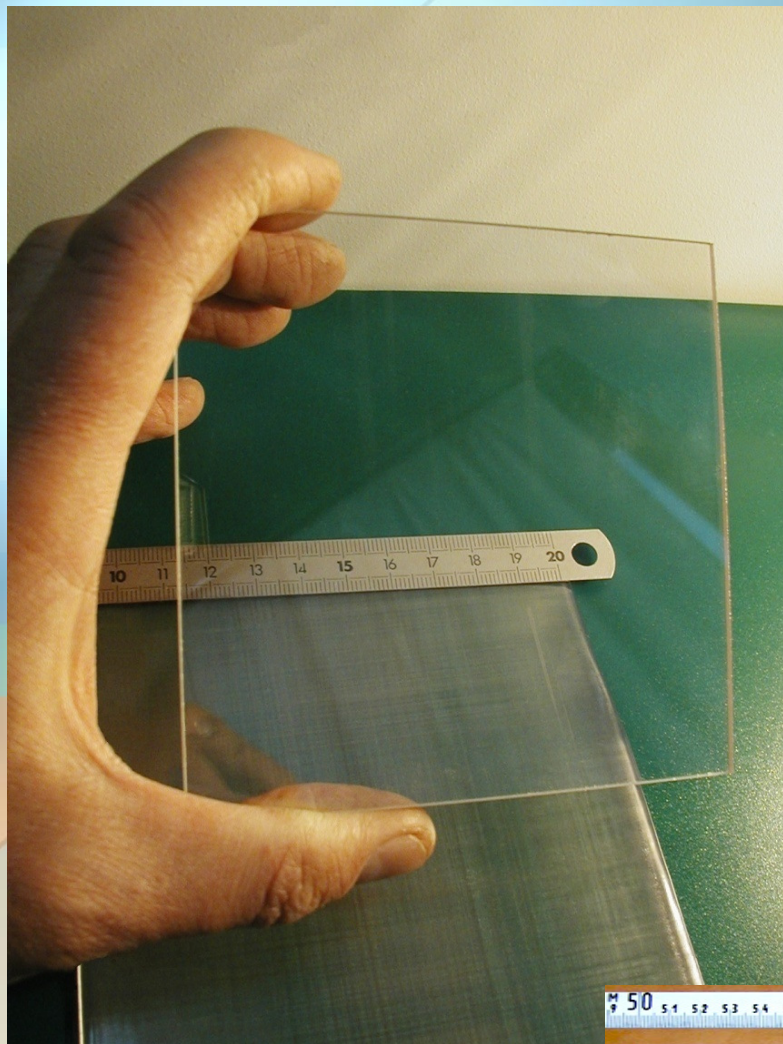


# Sapphire shaped crystals

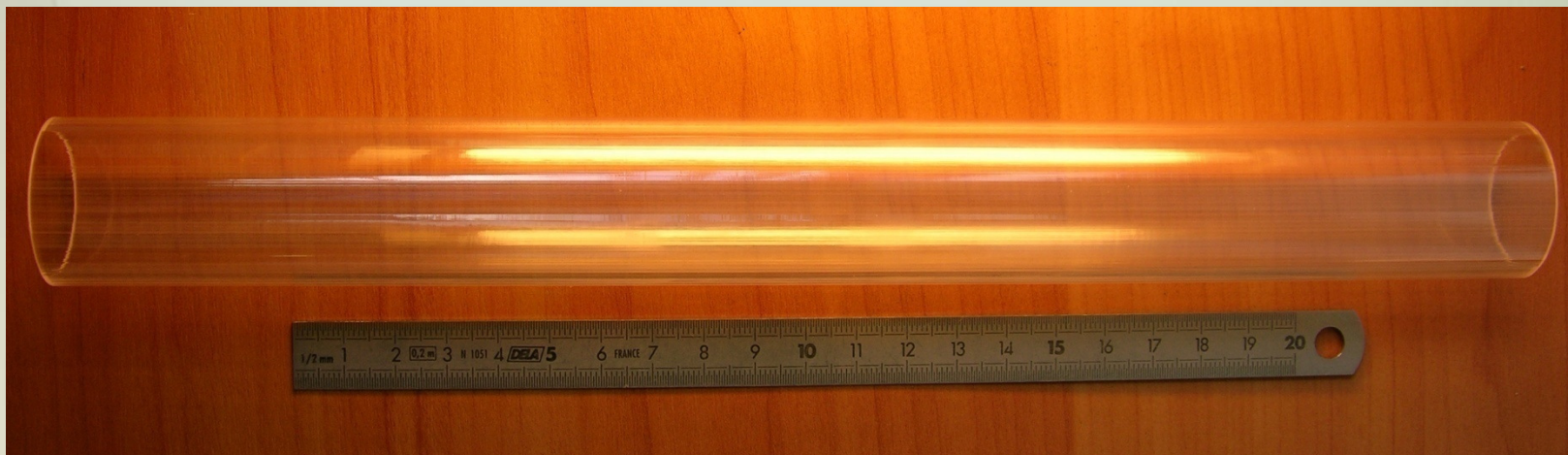
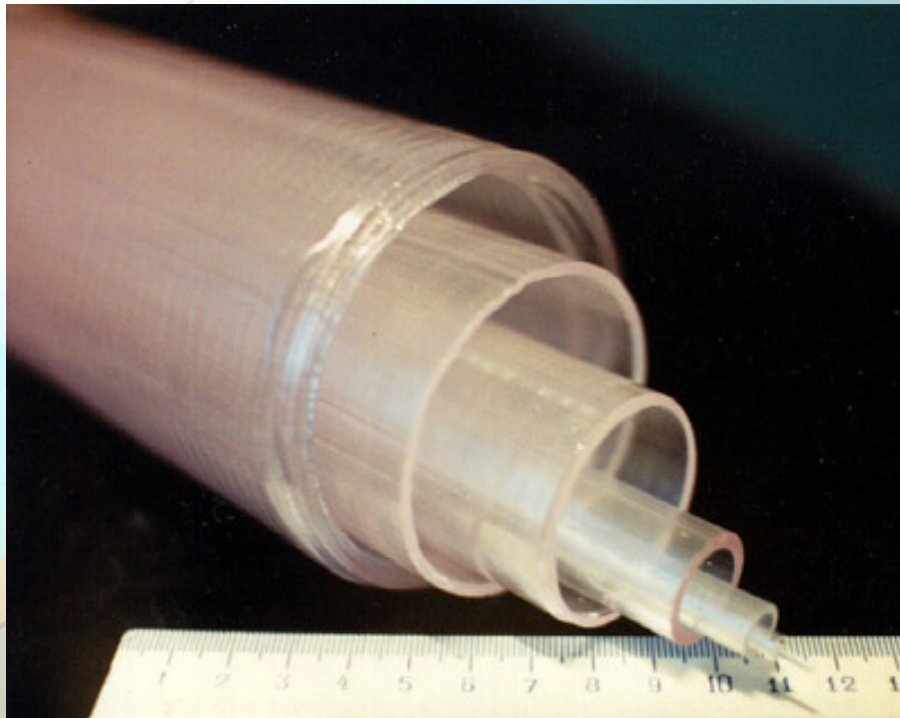
- cross-sections of shaped crystals are very close to the final geometry
- minimizing volume of labor efforts and corresponding losses of materials
- high growth rates
- growth of crystals with shapes or dimensions which impossible to grow or prepare from bulk crystals
- new fields of applications



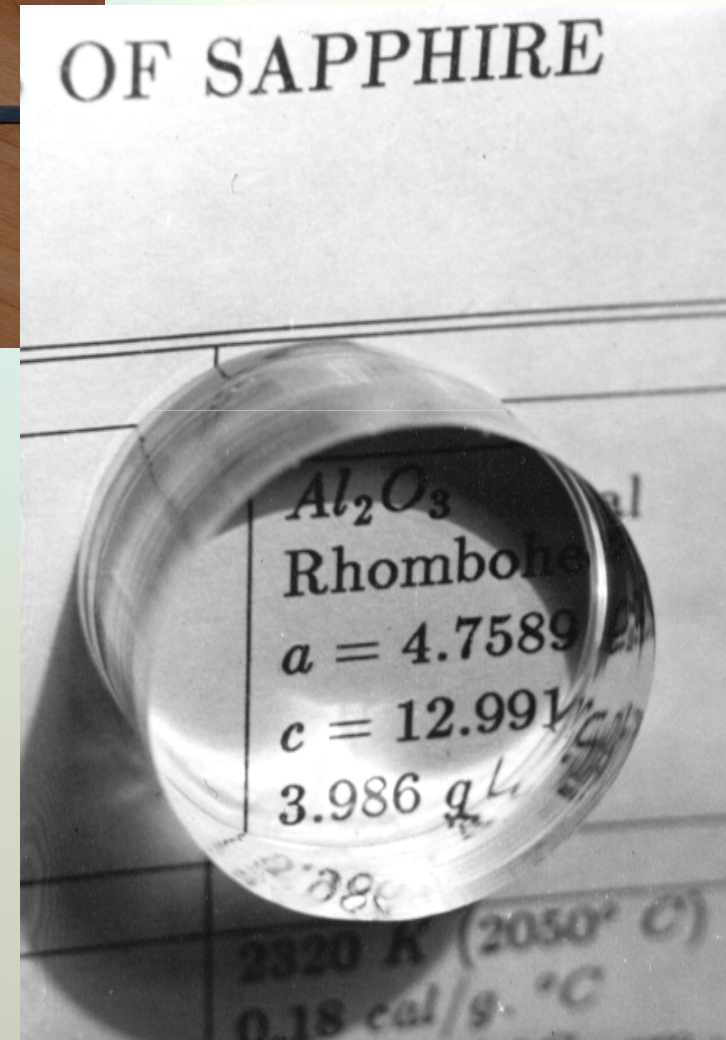
# Sapphire plates



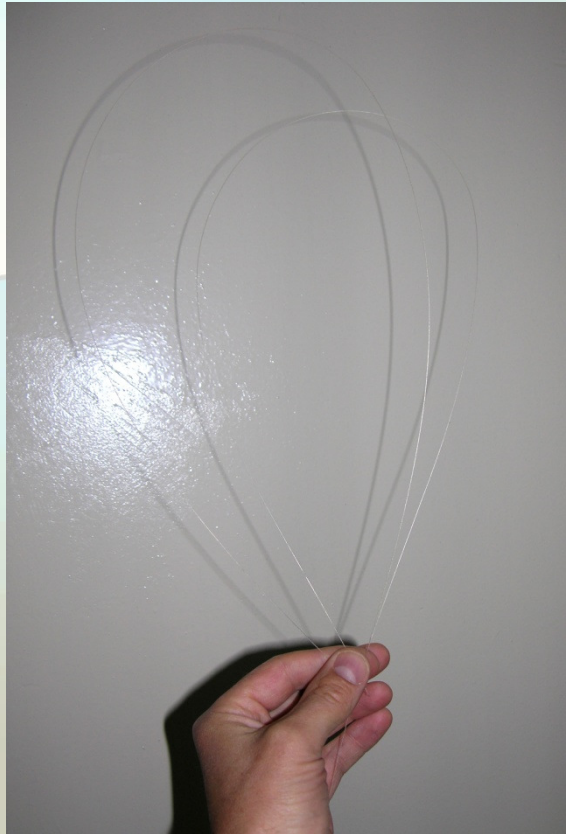
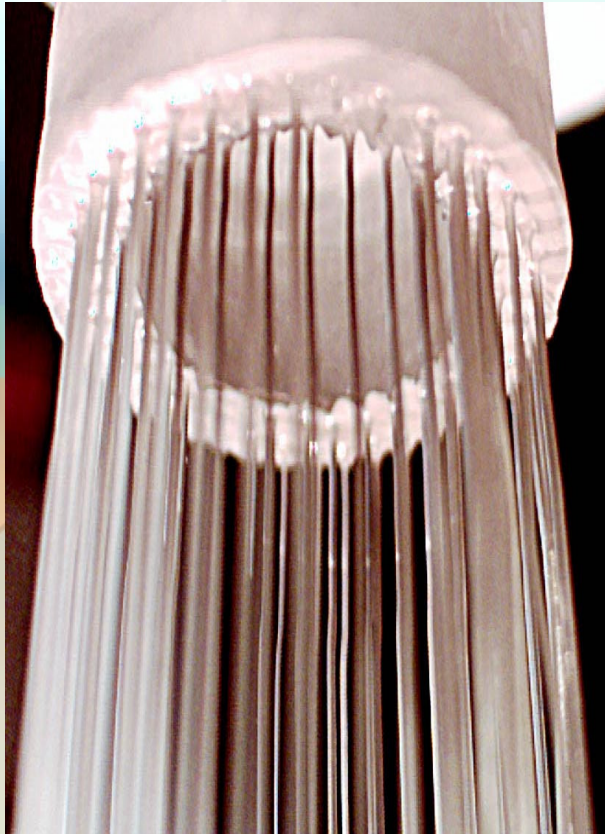
# Sapphire tubes



# Sapphire rods



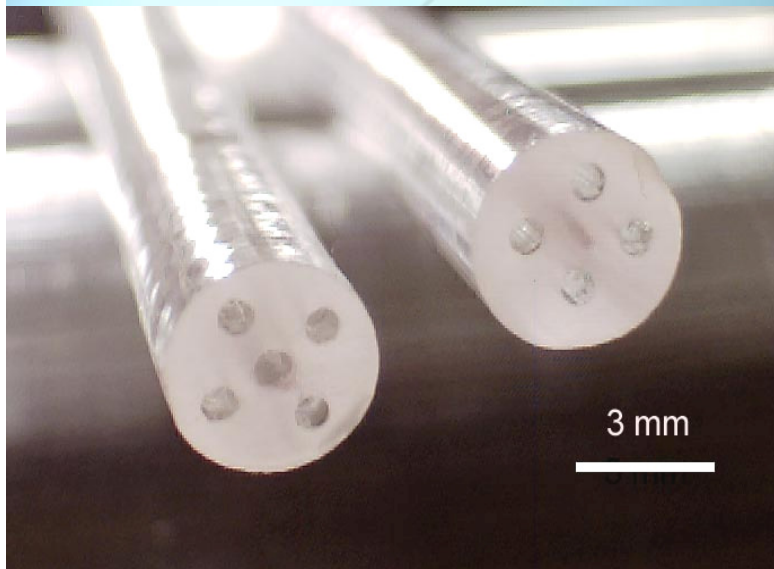
# Sapphire fibers



## ***Applications:***

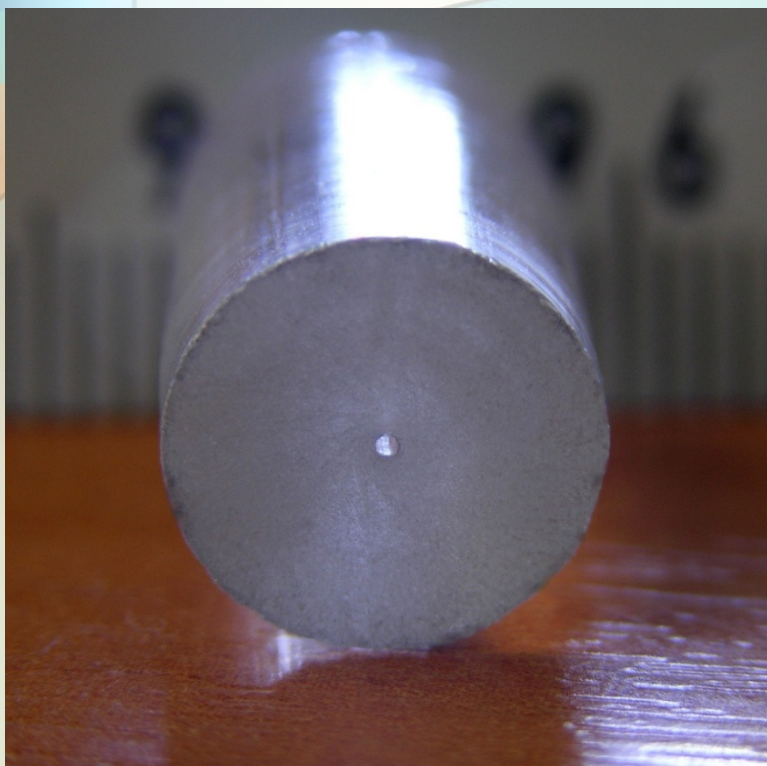
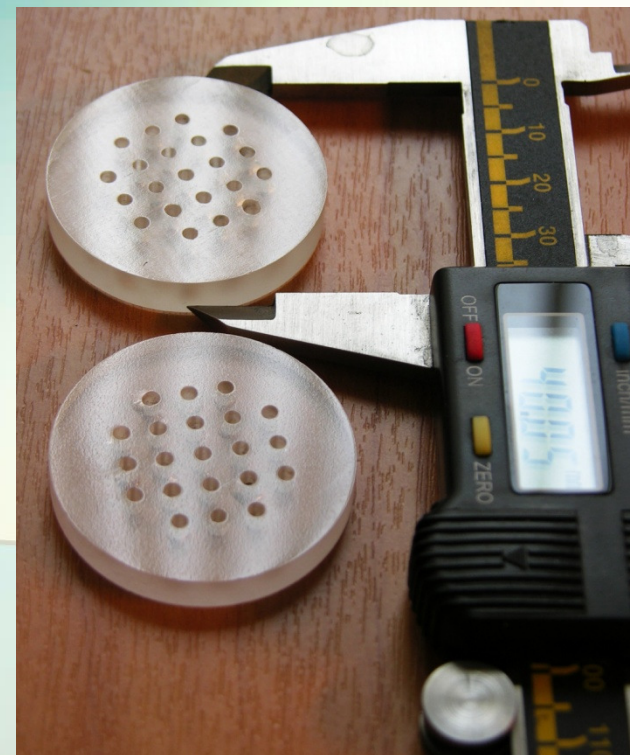
- light guides,
- reinforcing fibers for composite materials
- lasers
- laser delivery systems
- radiation detectors with high spatial resolution
- temperature and stress sensors

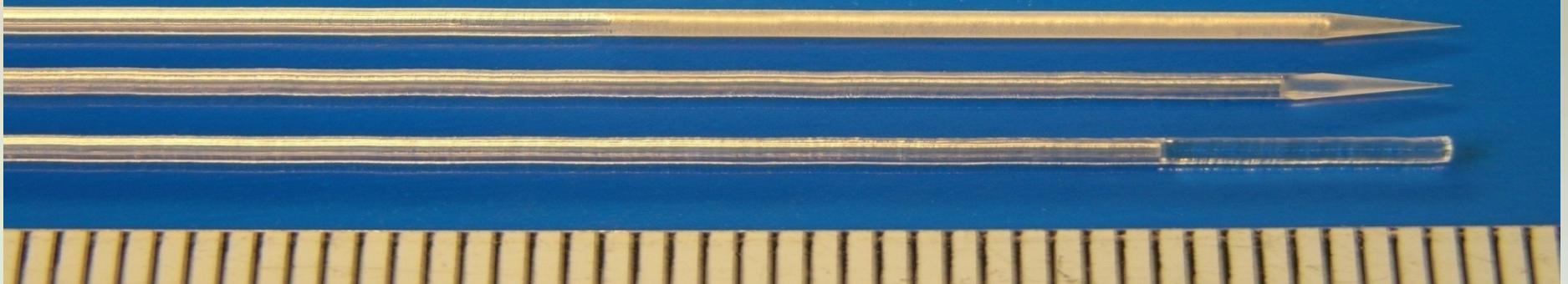
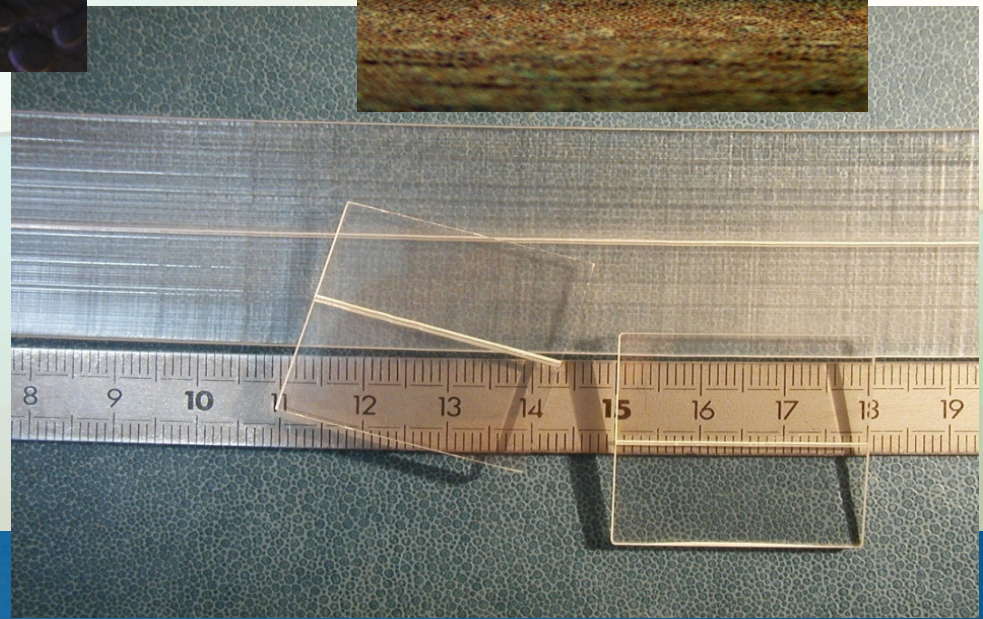
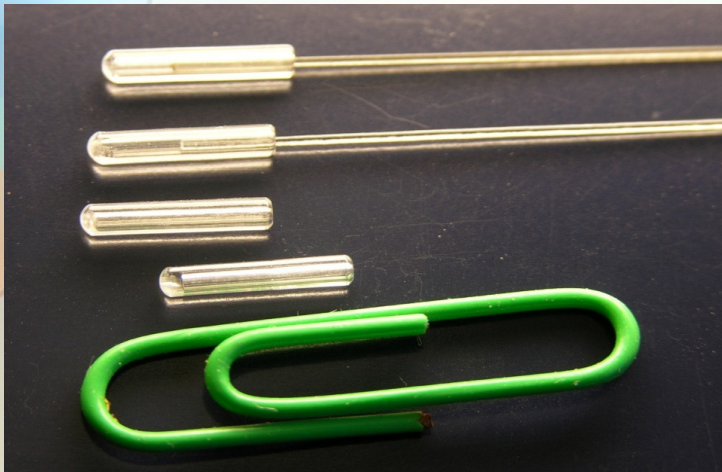
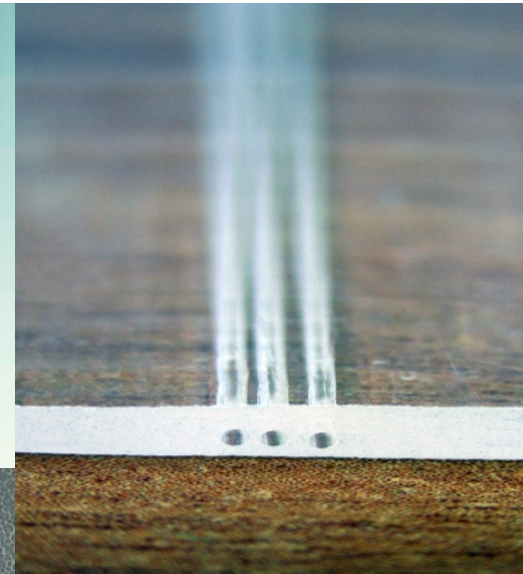
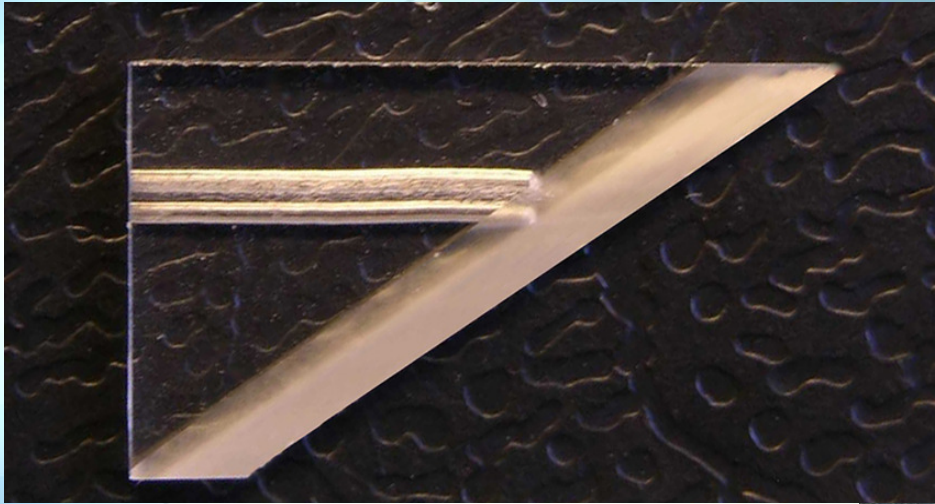




Shaped crystals with  
capillary channels

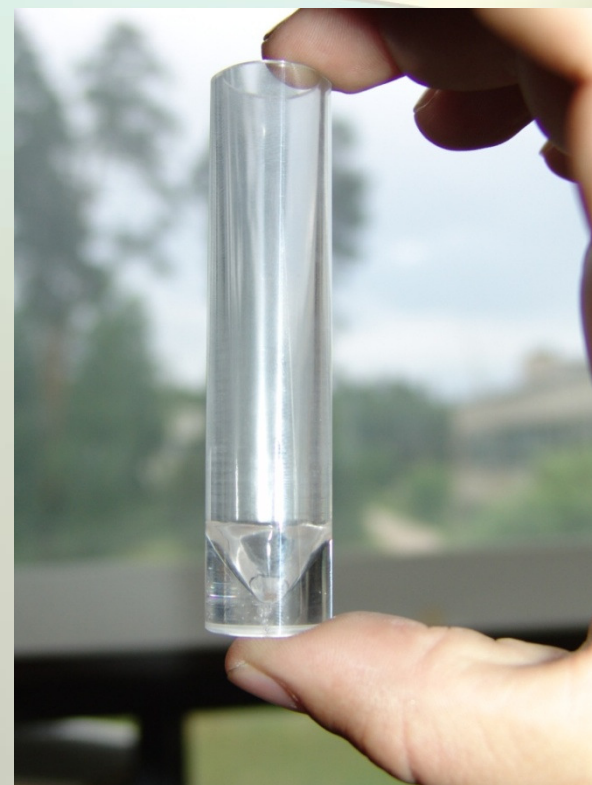
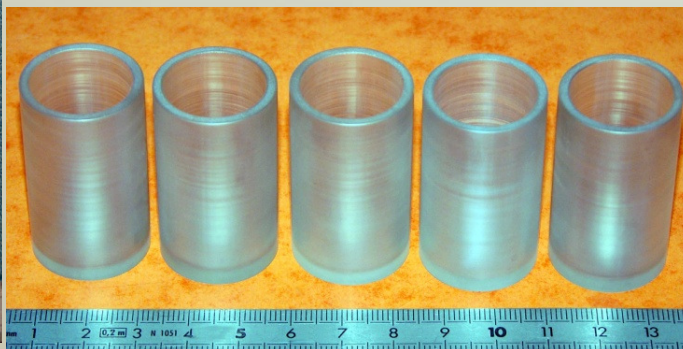
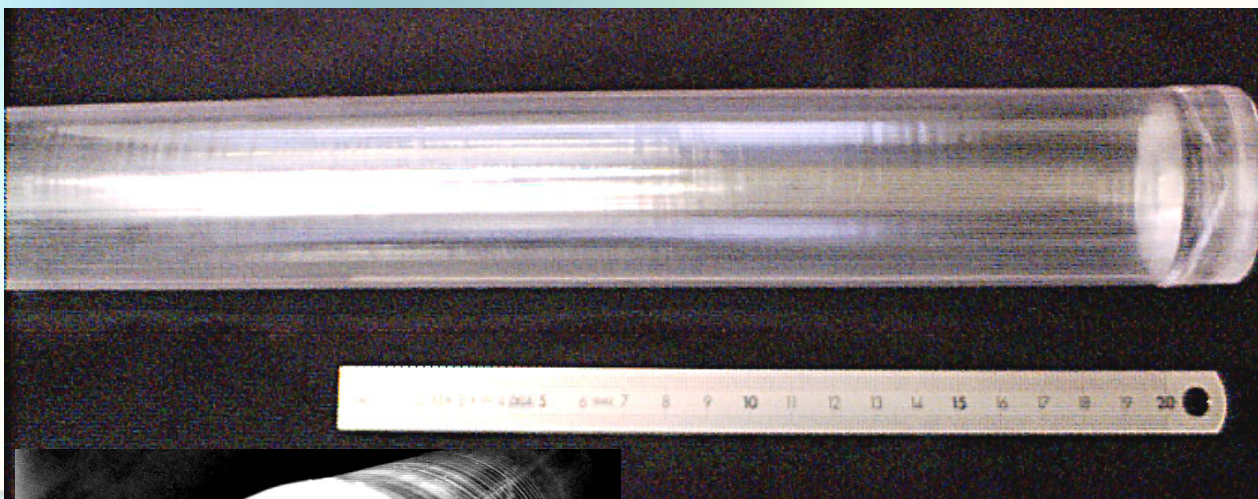
Minimal diameter  
of the channels –  
400  $\mu\text{m}$

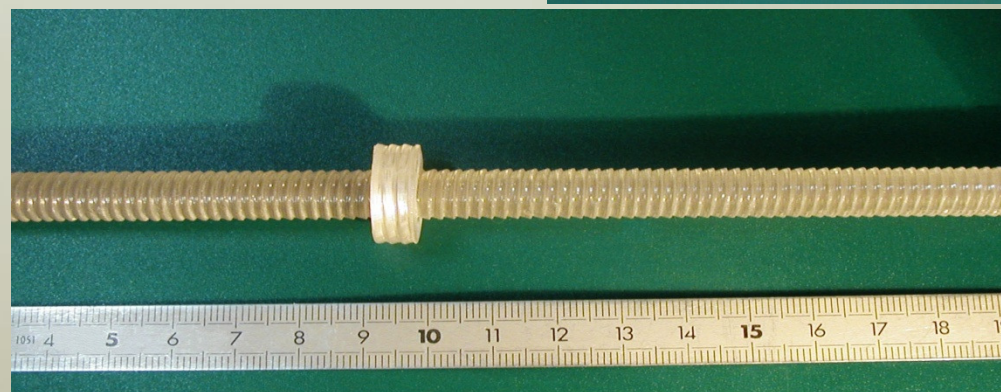
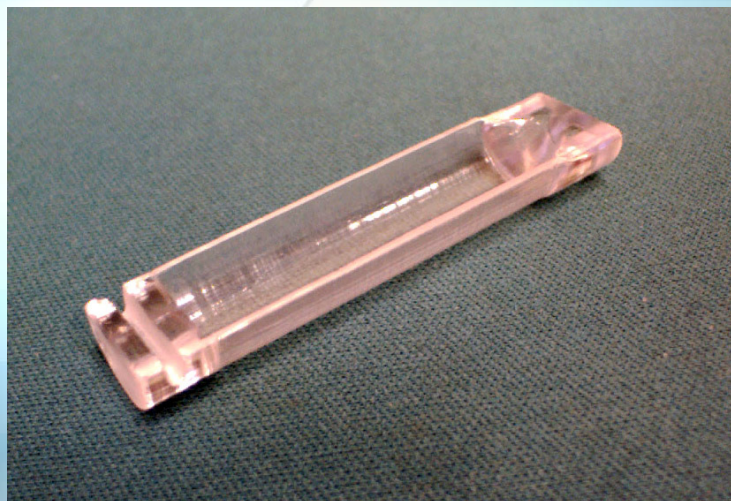






# Sapphire crucibles and boats



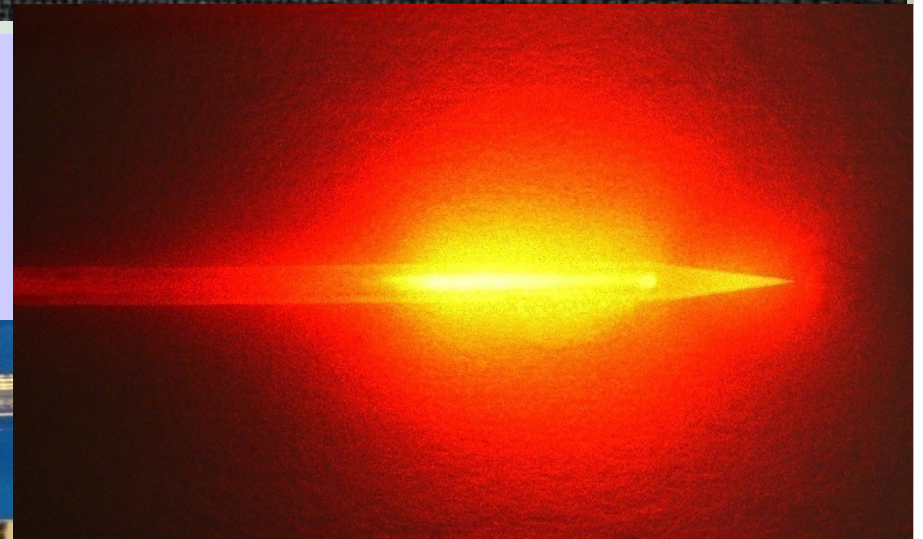
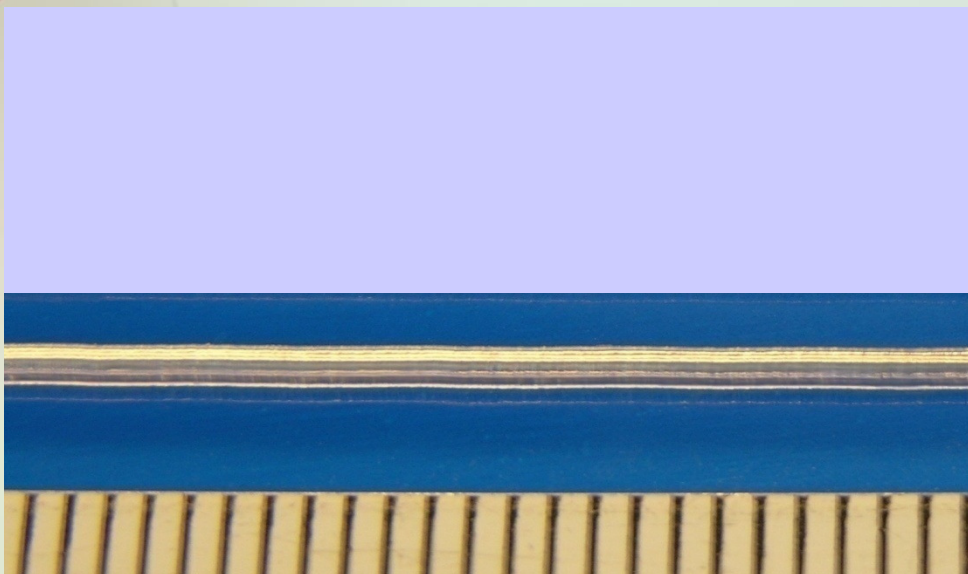
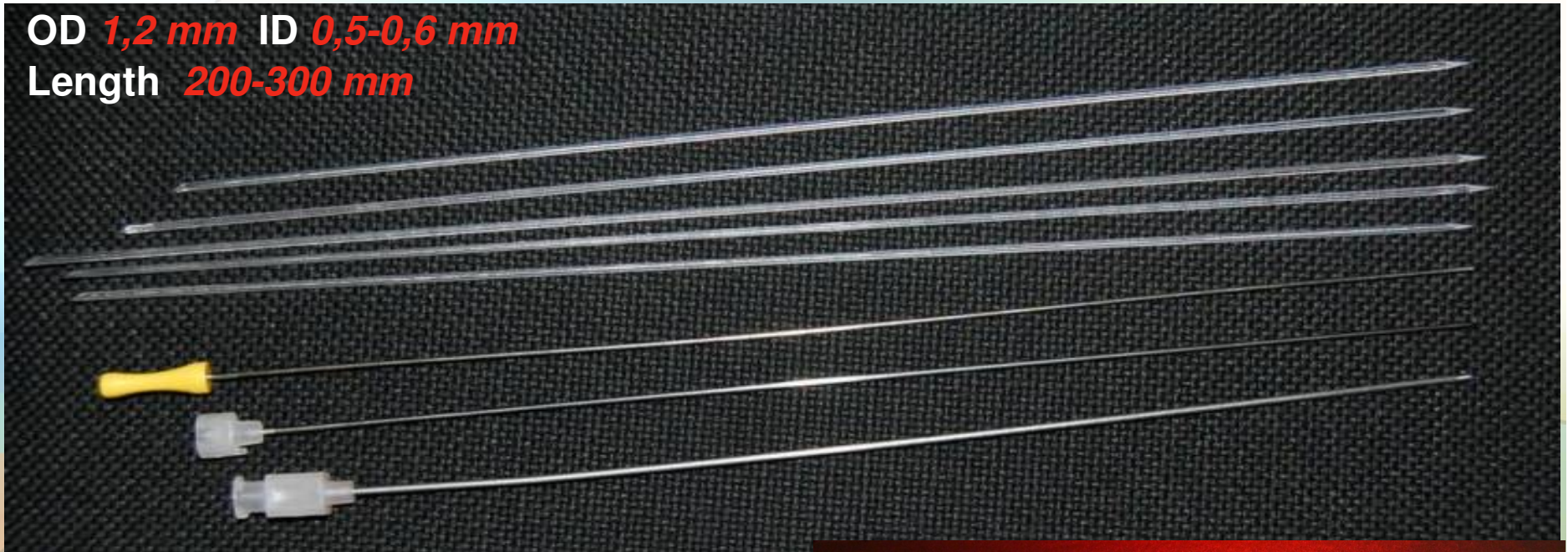






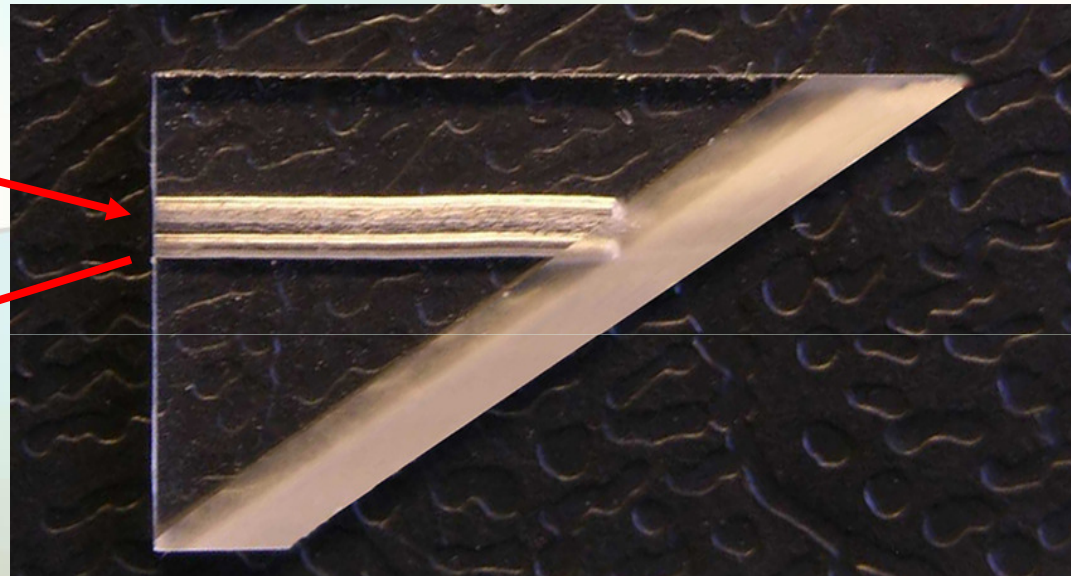
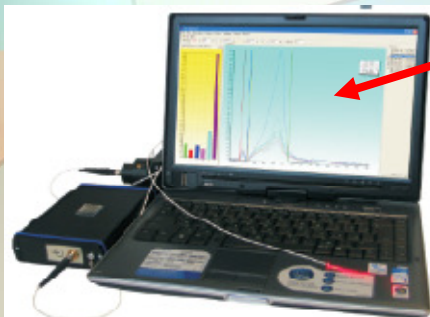
# Sapphire needles for and PDT thermotherapy

OD *1,2 mm* ID *0,5-0,6 mm*  
Length *200-300 mm*

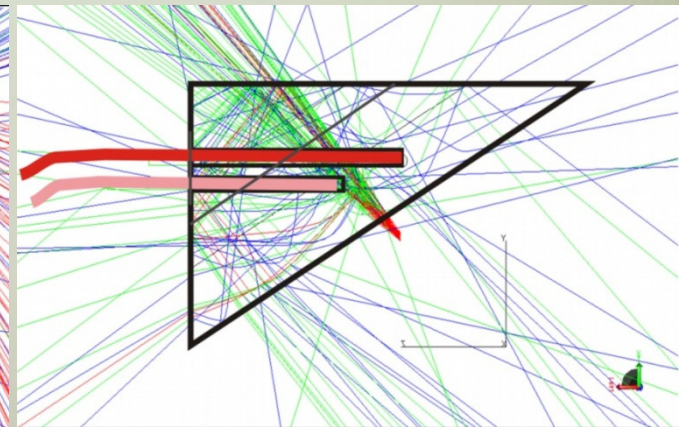
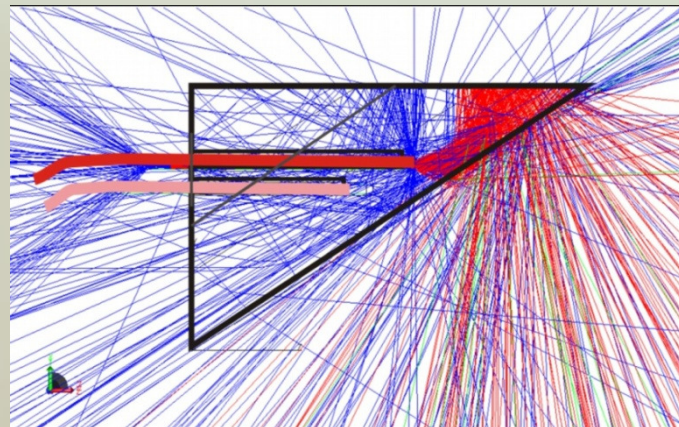


# Sapphire diagnostic scalpel (Smart scalpel)

An opportunity of forming of capillary channels in shaped sapphire crystals allows to make scalpels with an opportunity of a simultaneous incision and diagnostics of a resected tissue state close to cutting edge immediately during surgical operation.

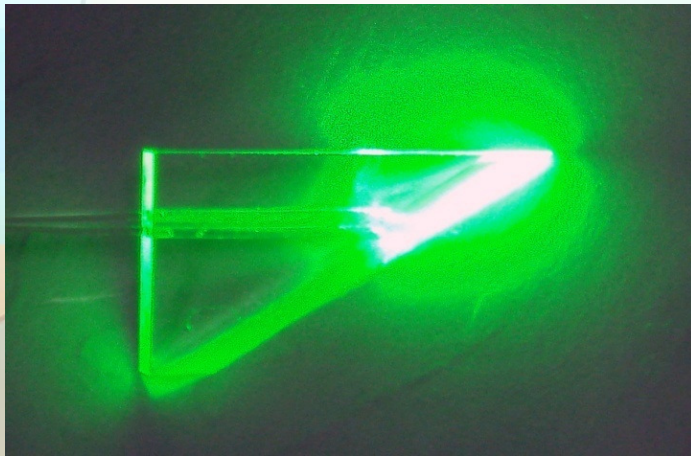


The two longitudinal channels with diameter of 0.5-0.6 mm to place optical fibers from laser and spectrometer



# Sapphire diagnostic scalpel (Smart scalpel)

An opportunity of forming of capillary channels in shaped sapphire crystals allows to make scalpels with an opportunity of a simultaneous incision and diagnostics of a resected tissue state close to cutting edge immediately during surgical operation.



**Possibility of  
coagulation during  
surgical operation**

