

# Electro-Optics:

## Optical Fibers

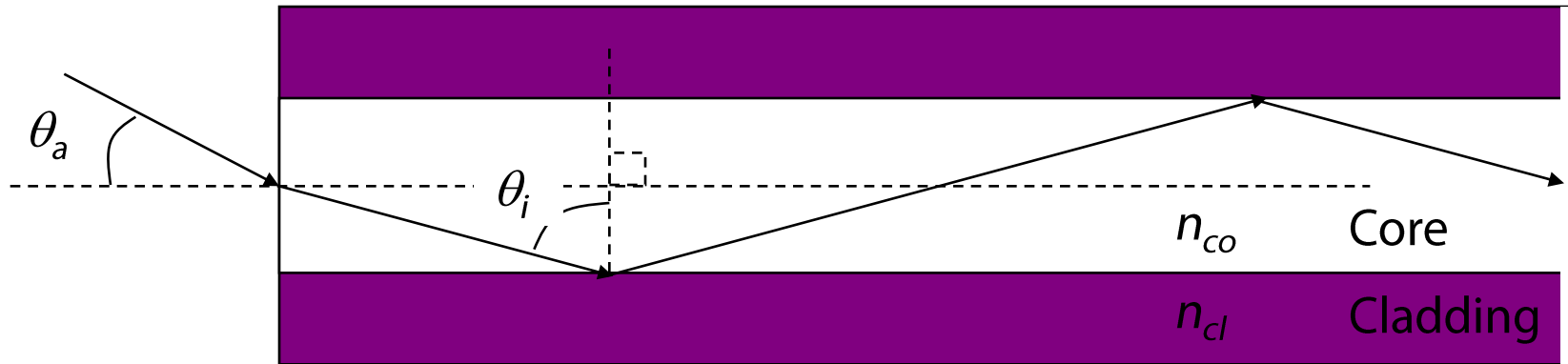
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# Optical Waveguides (1)



Total internal reflection:

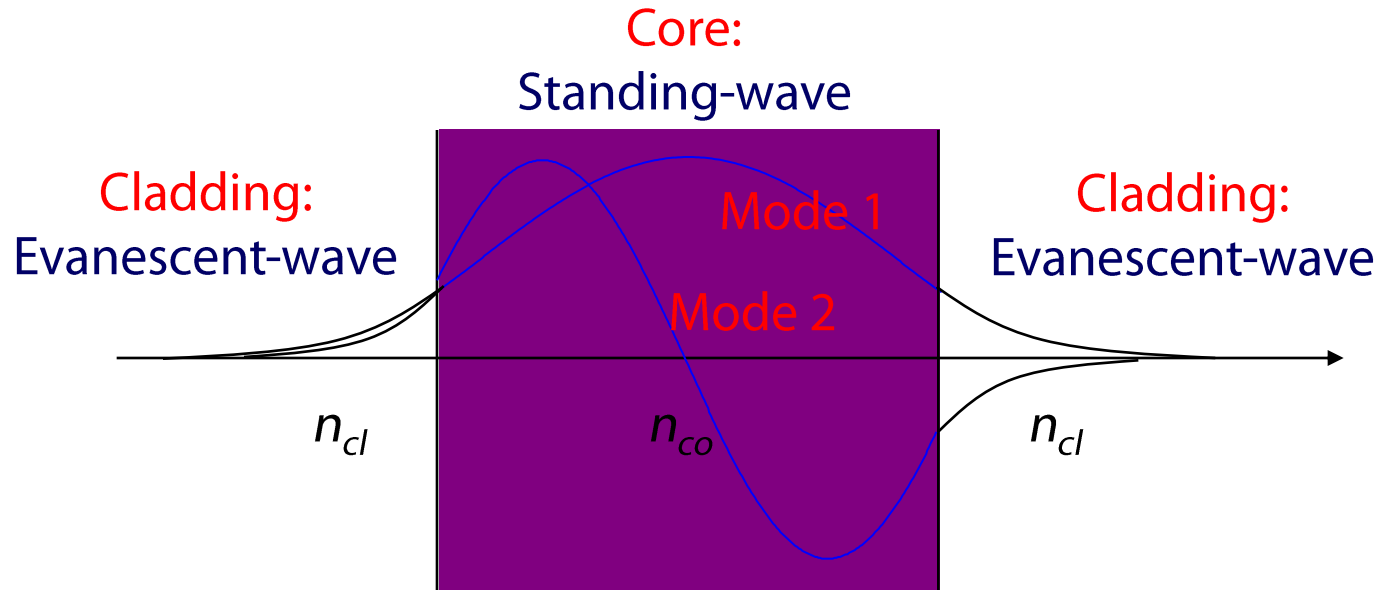
$$\theta_i > \theta_c = \sin^{-1}\left(\frac{n_{cl}}{n_{co}}\right)$$

Numerical aperture:

$$NA = n_o \sin \theta_a \approx \theta_a = \sqrt{n_{co}^2 - n_{cl}^2}$$

# Optical Waveguides (2)

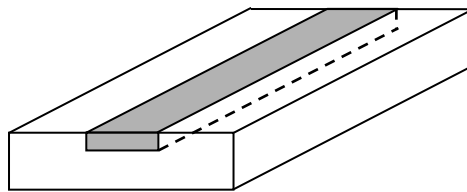
Quantized mode states:



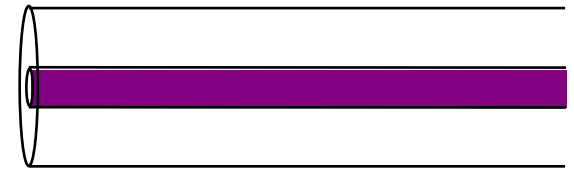
Planar W/G:



Channel W/G:



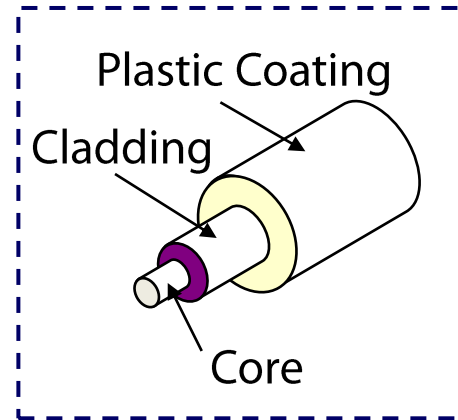
Circular W/G:



# Optical Fibers

A flexible optically transparent fiber, as of glass or plastic, through which light can be transmitted by successive internal reflection

Structure of Optical Fiber:



## Various Optical Fibers

Step-index  
multimode fiber  
(MMF)

Graded-index  
multimode fiber  
(GRIN MMF)

Single-mode  
fiber (SMF)

Dispersion-  
compensation  
Fiber (DCF)

# Fabrication of Optical Fibers

Double crucible:

→ Direct drawing

Rod in tube:

→ Preform and drawing

# Fabrication of Fiber Preforms

Deposition techniques:

Modified chemical vapor deposition (MCVD)

Plasma-enhanced modified chemical vapor deposition (PMCV

Outside vapor deposition (OVD)

Axial vapor deposition (AVD)

# Preform Fabrication by MCVD

MCVD: Modified chemical vapor deposition

Dopants:  $\text{GeO}_2$ ,  $\text{P}_2\text{O}_5$ ,  $\text{ErCl}_3$ ,  $\text{Nd}_2\text{O}_3$

# Fiber Drawing and Spooling

Procedure:

- Drawing from preform
- Quality checking
- Coating for protection
- Spooling