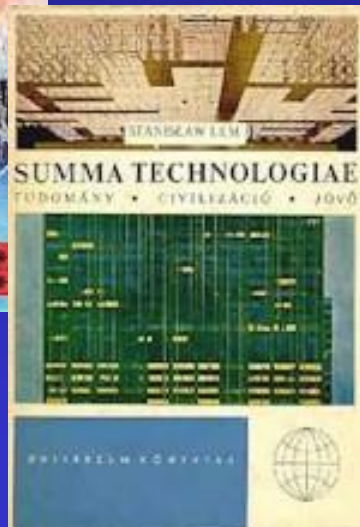
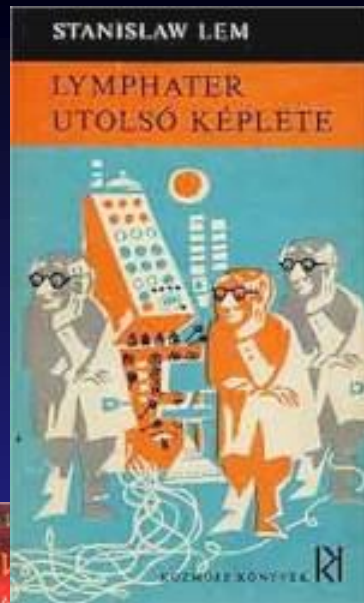


Bioelektronika II

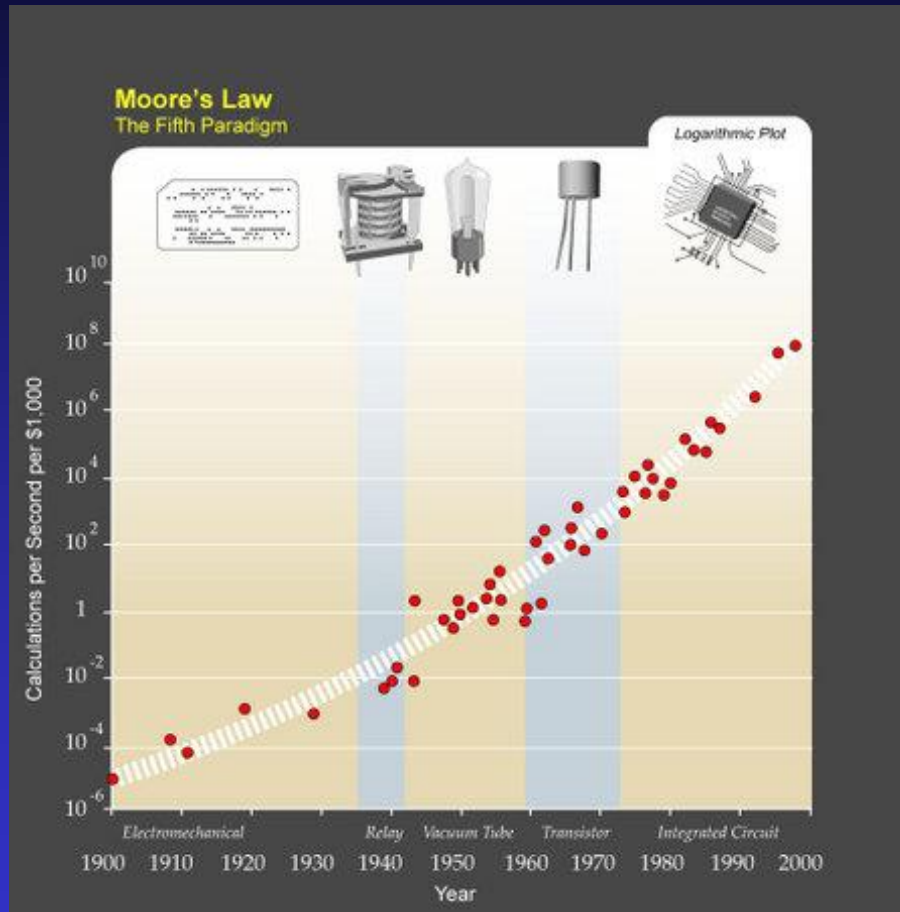
Hogyan segíthet a biológia az információtechnikanak?

Dér András
MTA SZBK Biofizikai Intézet

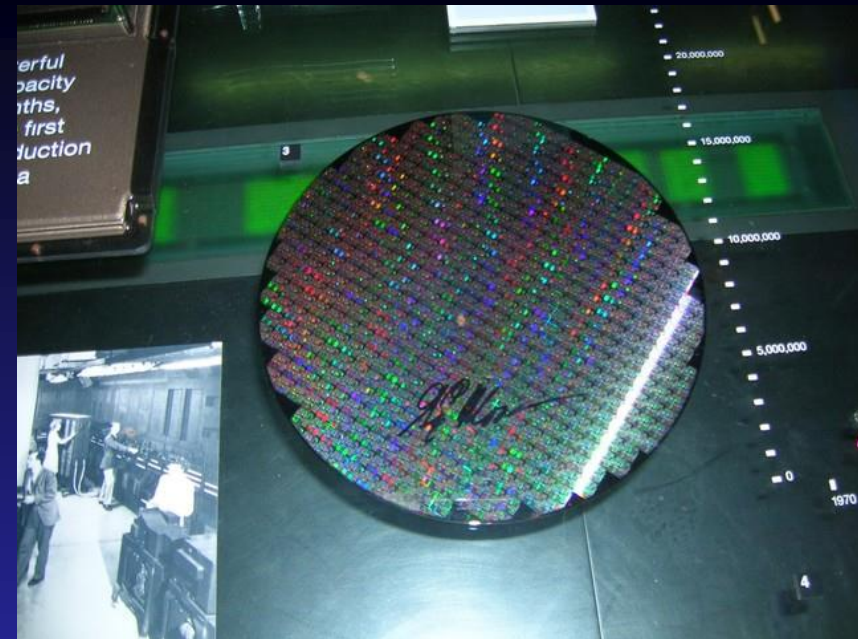
Science - fiction



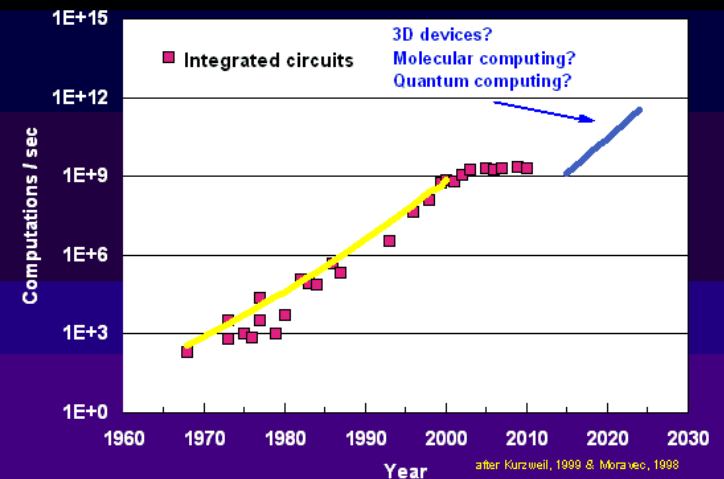
Moore törvénye



Új alapelvek, anyagok,
eljárások!



2006 - Moore's Lapse?

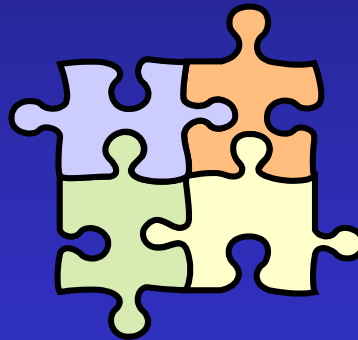
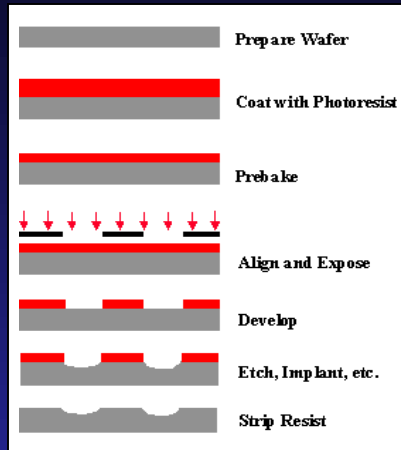


Miniatürizálás

Litográfiai eljárások:
molekuláris méreteknel
nehézségek



Alulról építkezés
(„bottom up”):
**Molekuláris
elektronika**



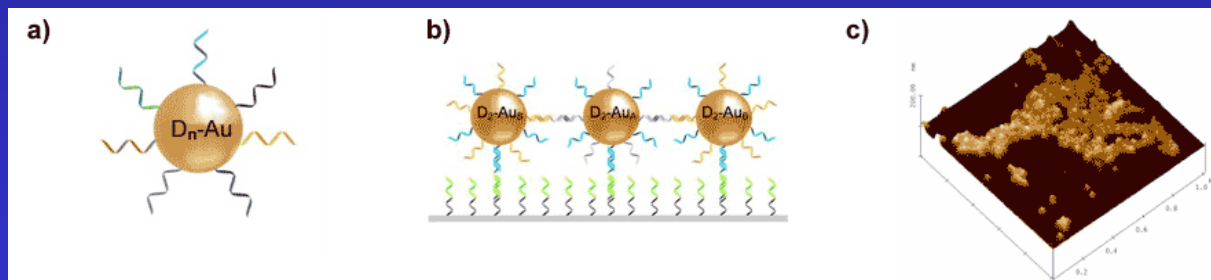
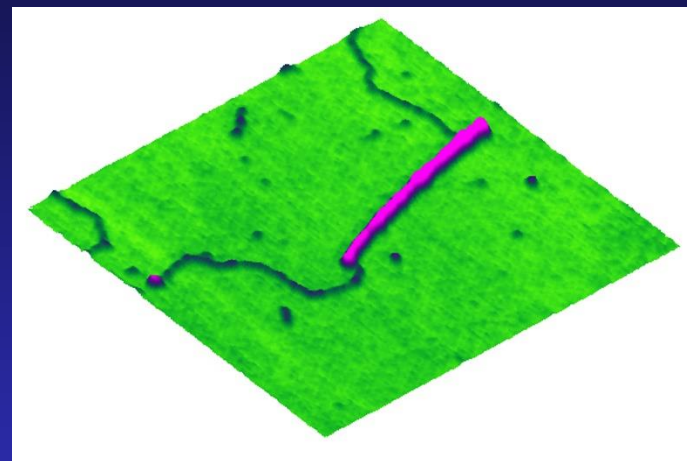
**Szén nanocsövek jó vezetők.
Hálózat?**

Biológiai anyag

Önszerveződésre képes, speciális funkciókra optimalizált

Bioelektronika:

Biológiai
makromolekulák
(fehérjék,
nukleinsavak)

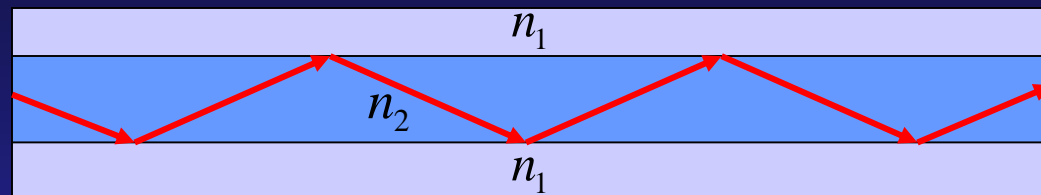


Lem jóslata valóra válik?

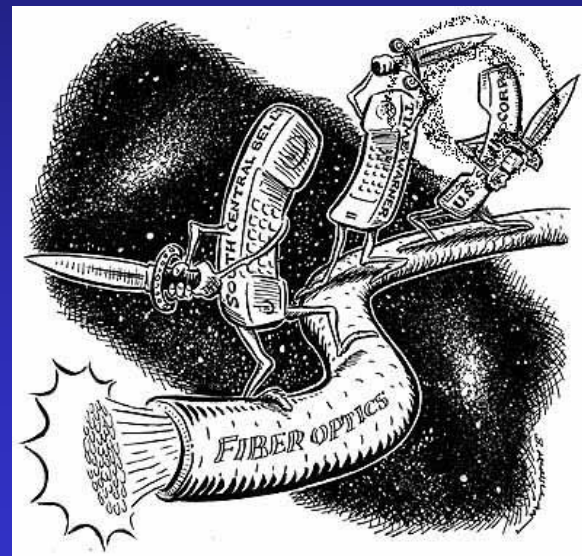
Kommunikáció fénnnyel



Optikai fényvezető kábel

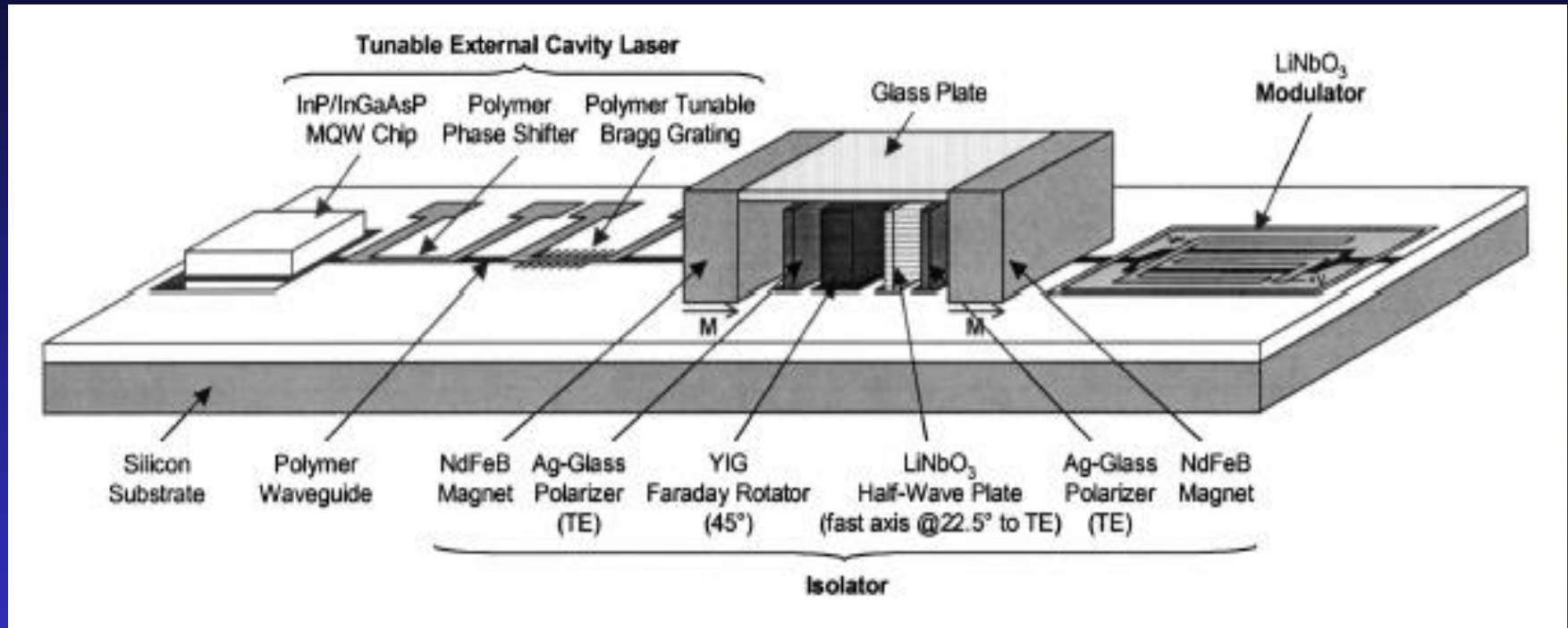


$$n_1 < n_2$$



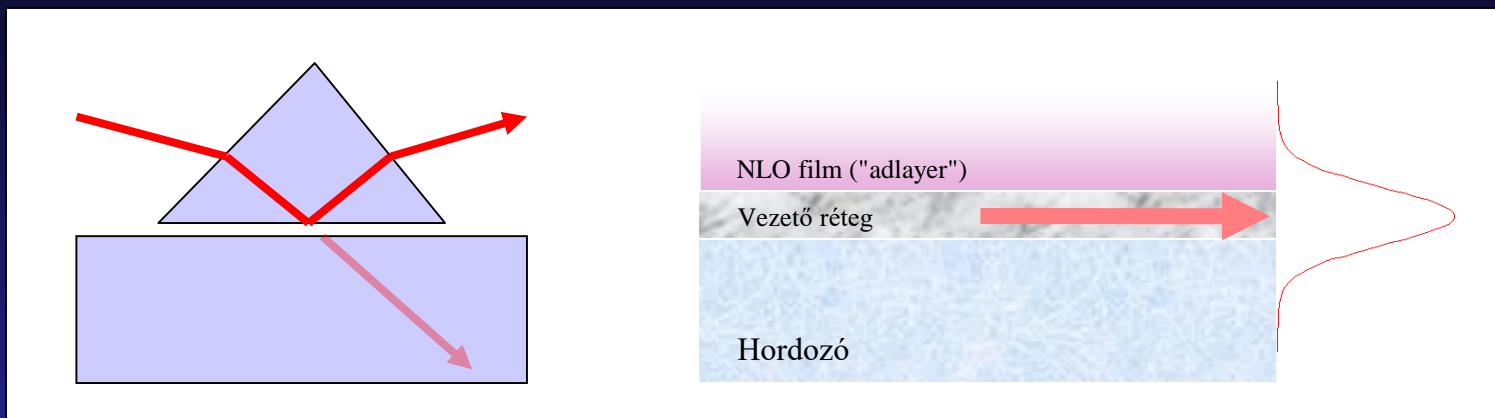
Lehetne ezt kicsiben is?

Integrált optika

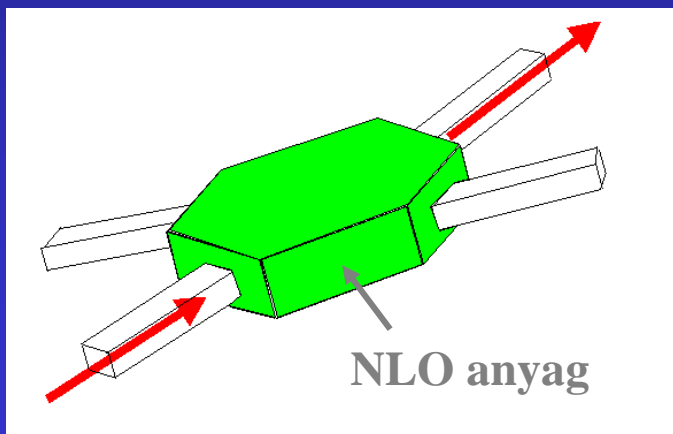


“Szűk keresztmetszet”: megfelelő nemlineáris optikai (NLO) kapcsolóanyagok - külső hatásra (elektromos, mágneses tér, fény) törésmutatóváltozás

Az „evaneszcens” fény



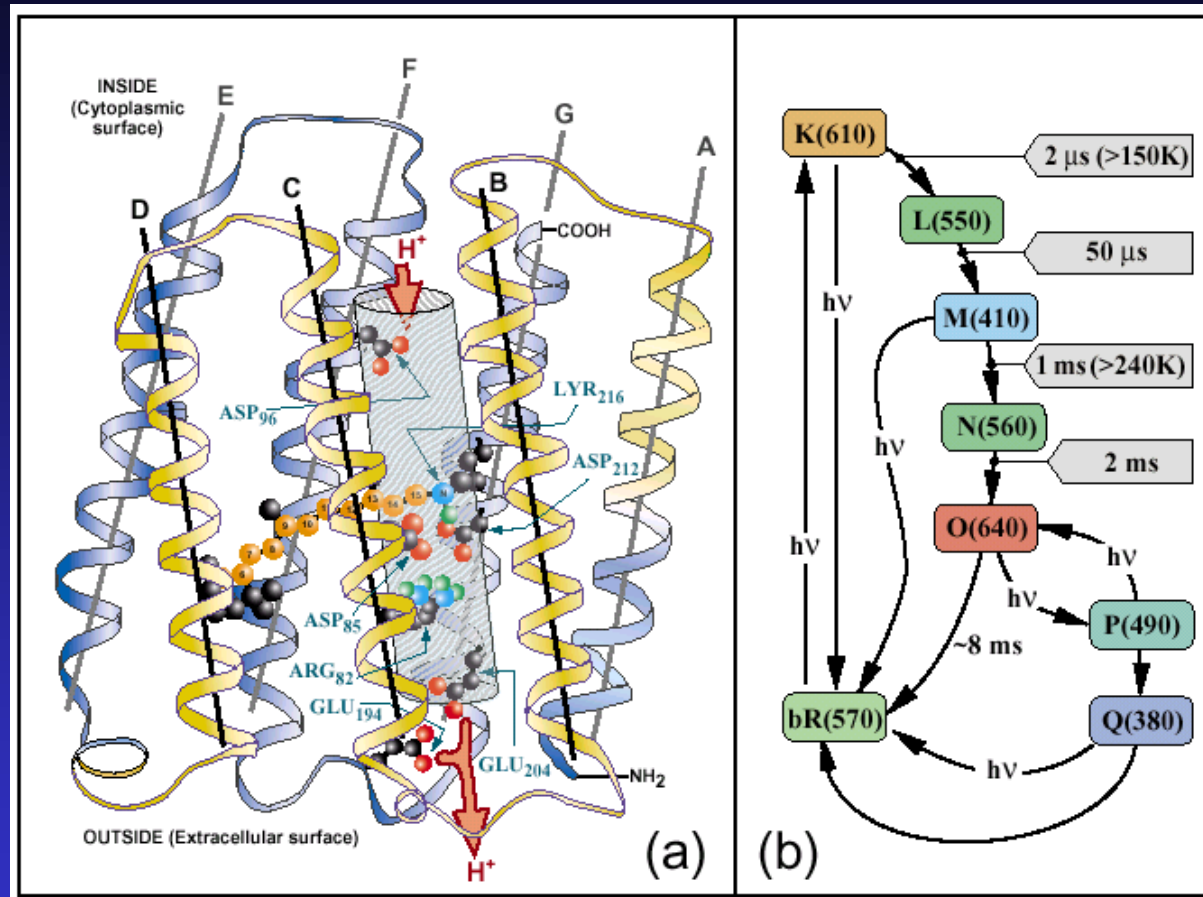
Integrált optikai kapcsoló



Jó lenne kizárólag fényvezérelt áramköröket készíteni.

Követelmények: fény hatására törésmutatóváltozás, gyors kinetika, stabilitás

A bR modellszerepet tölt be az ionpumpáló membránfehérjék között

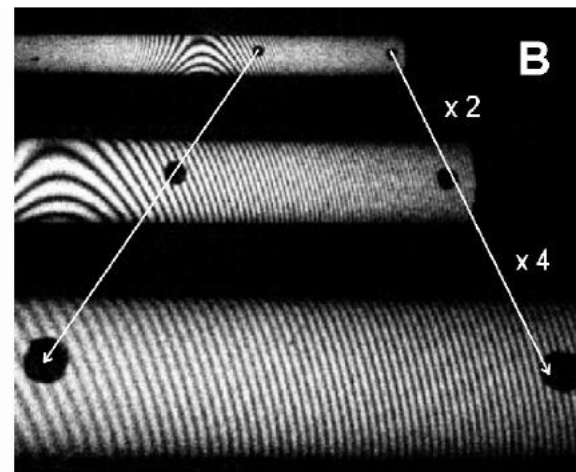
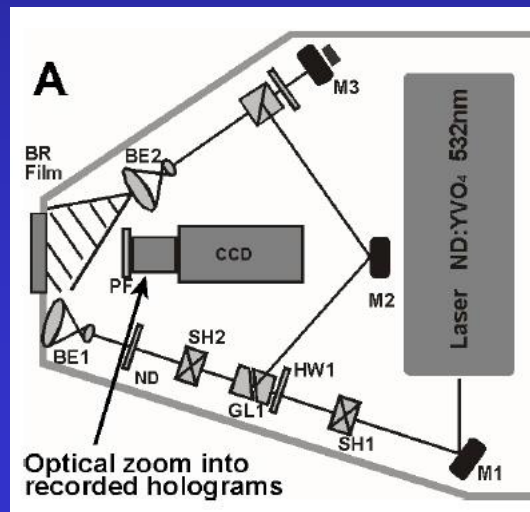
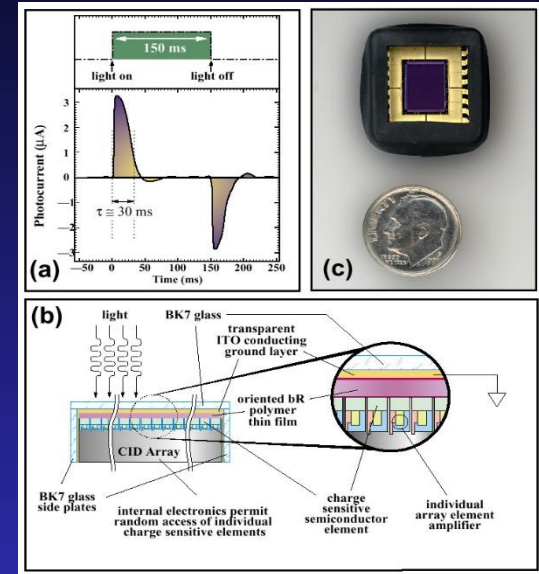


Közel vagyunk az atomi szintű leíráshoz

Génszabványozással, kémiai, fizikai módosítással tetszés
szerint alakíthatjuk

Bioelektronikai alkalmazások (bR-alapú filmek)

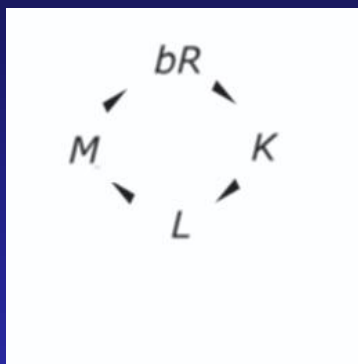
Keck Center for Molecular
Electronics at Syracuse
University



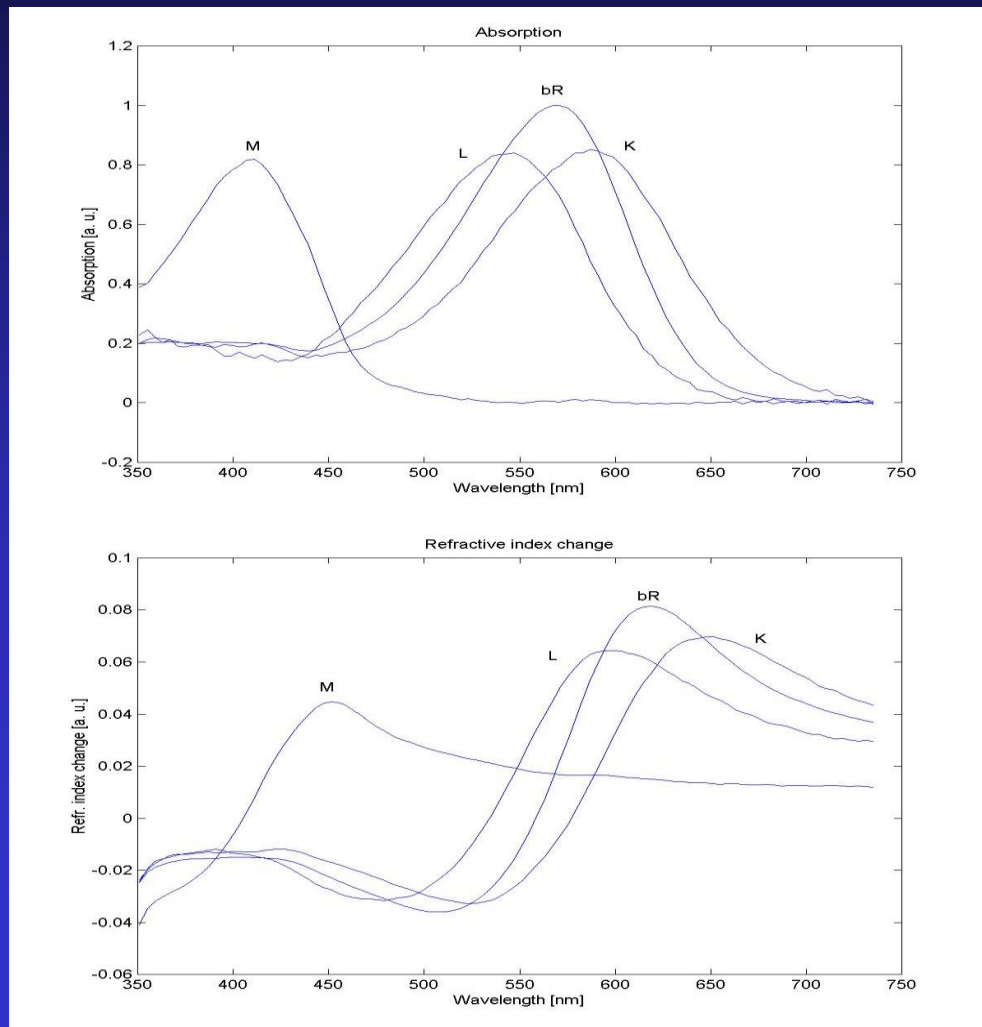
Institute of Physical Chemistry
University of Marburg

Integrált optikai alkalmazás

Nemlineáris optikai tulajdonság: a törésmutató megvilágítás hatására változzon



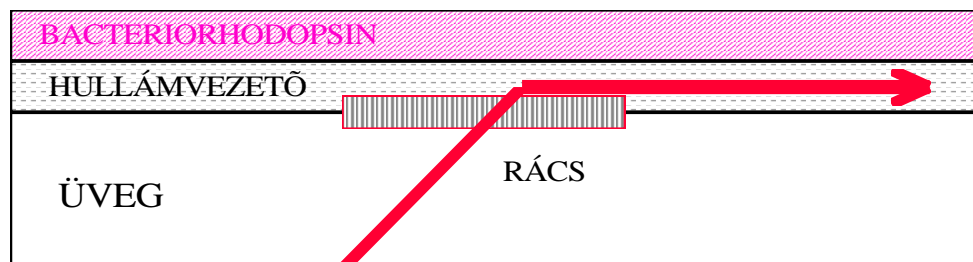
Kramers-Kronig
relációk



A törésmutató mérése

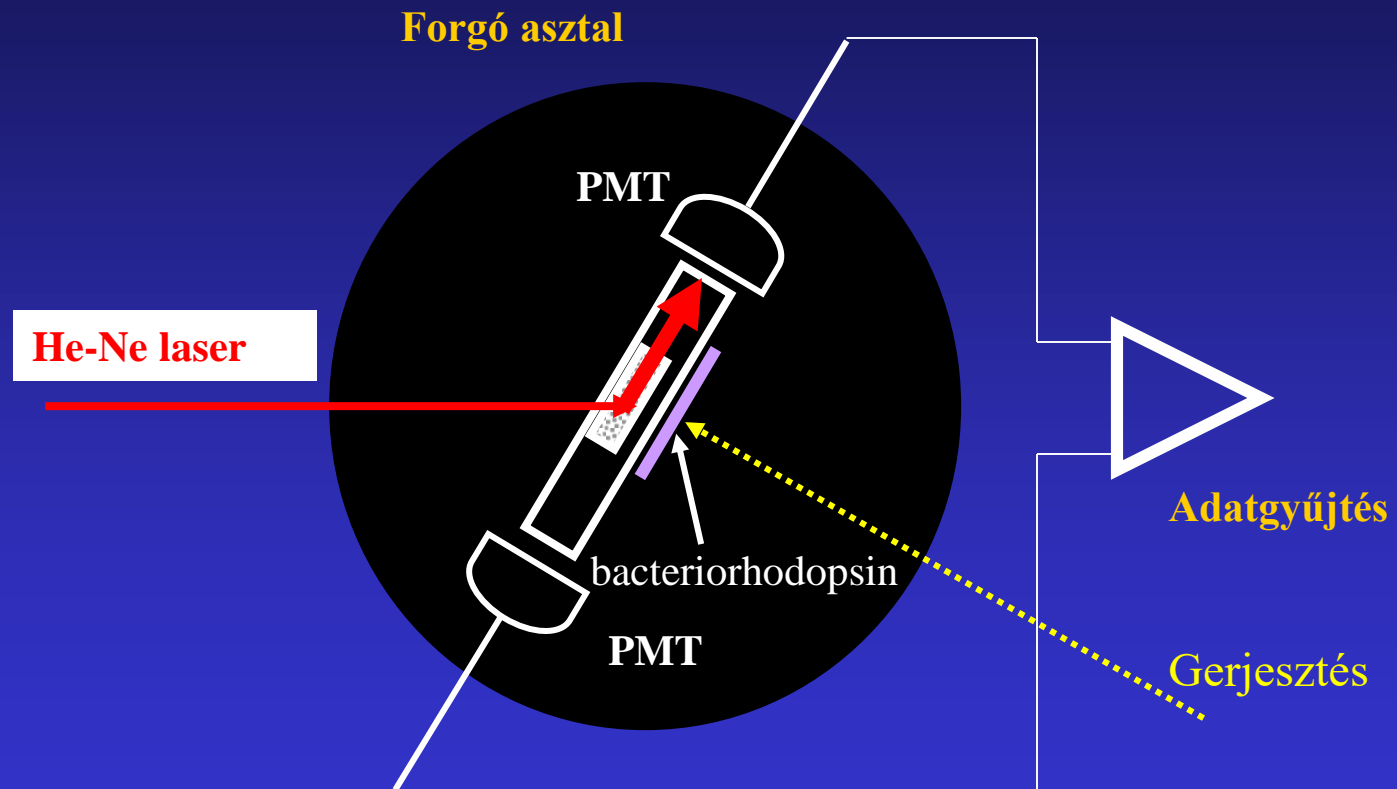
- üveg hordozó $n_s=1.526 - 1.532$
- hullámvezető réteg ($n_F=1.77 - 2.3$, $d \sim 200$ nm)
- adalék réteg ($d > 1 \mu\text{m}$)
- csatoló rács (2400 - 2700 vonal/mm)

A rács csatolású hullámvezető sémája

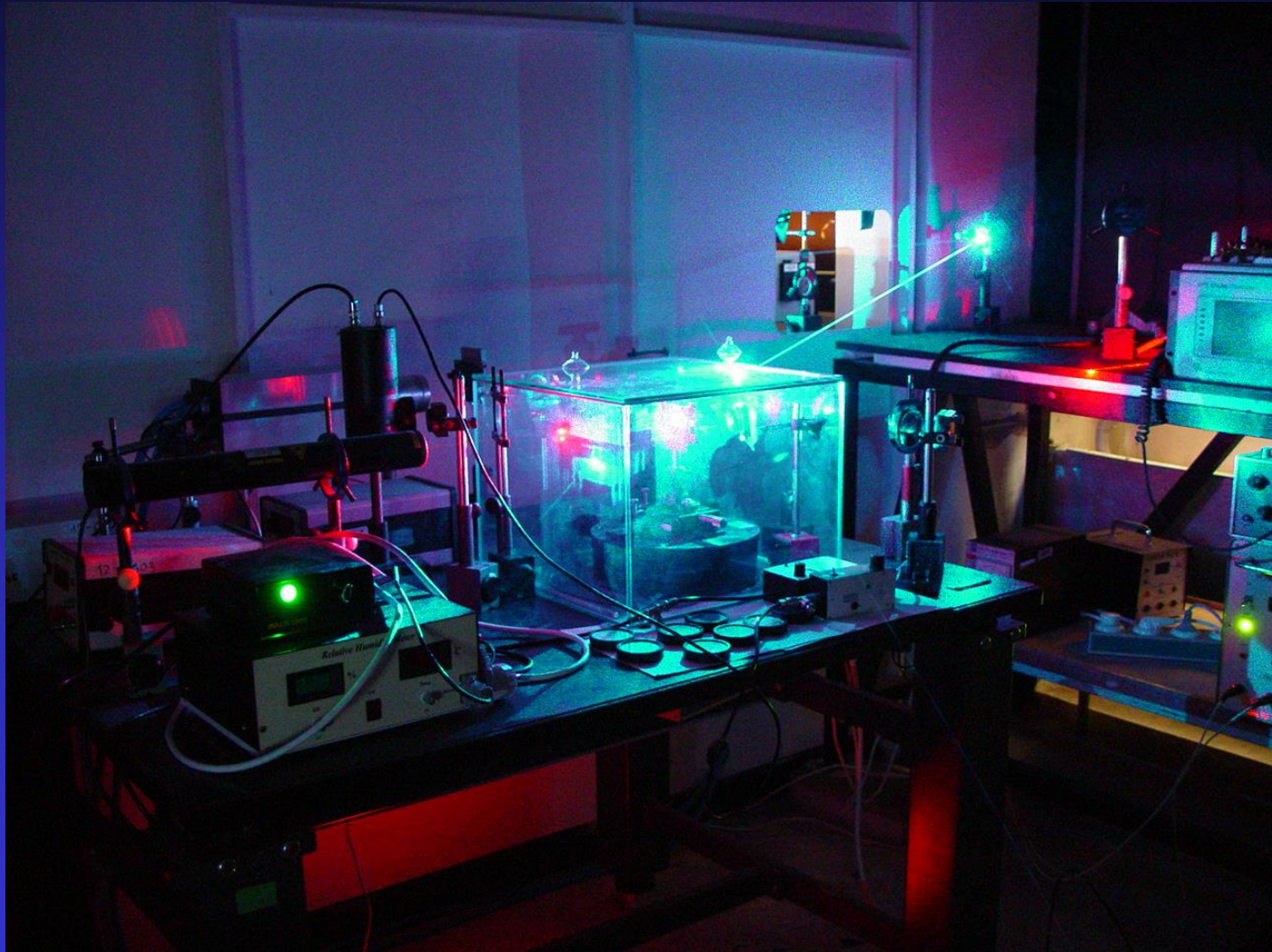


He-Ne lézer fény

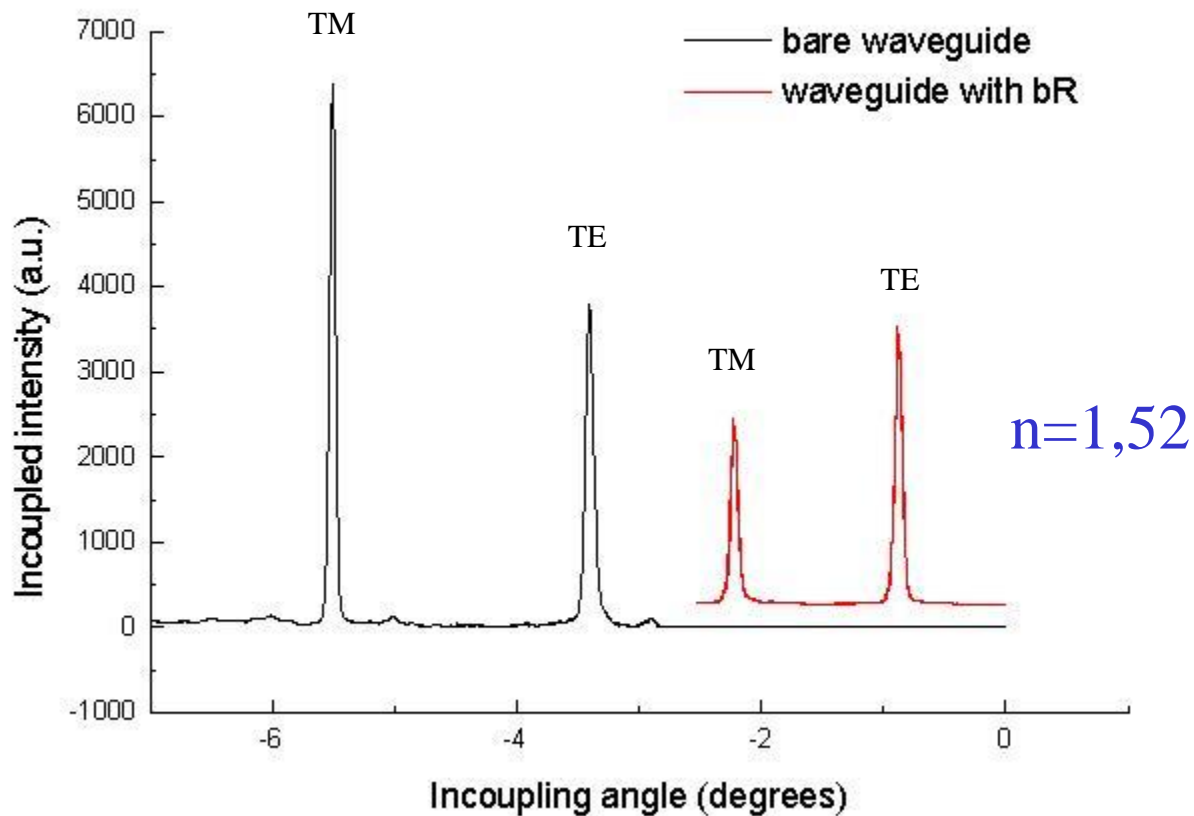
A mérőrendszer



A mérőhely

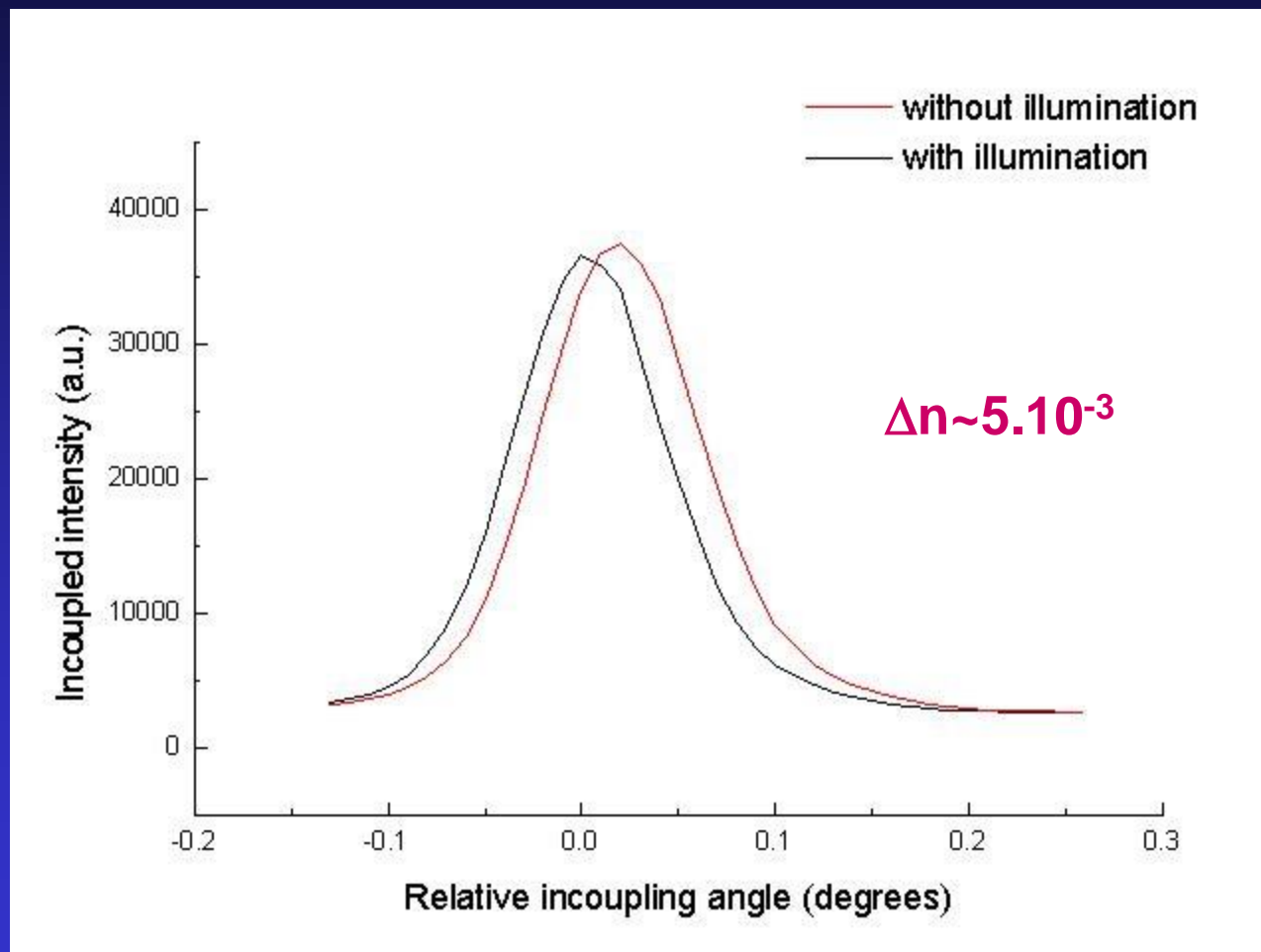


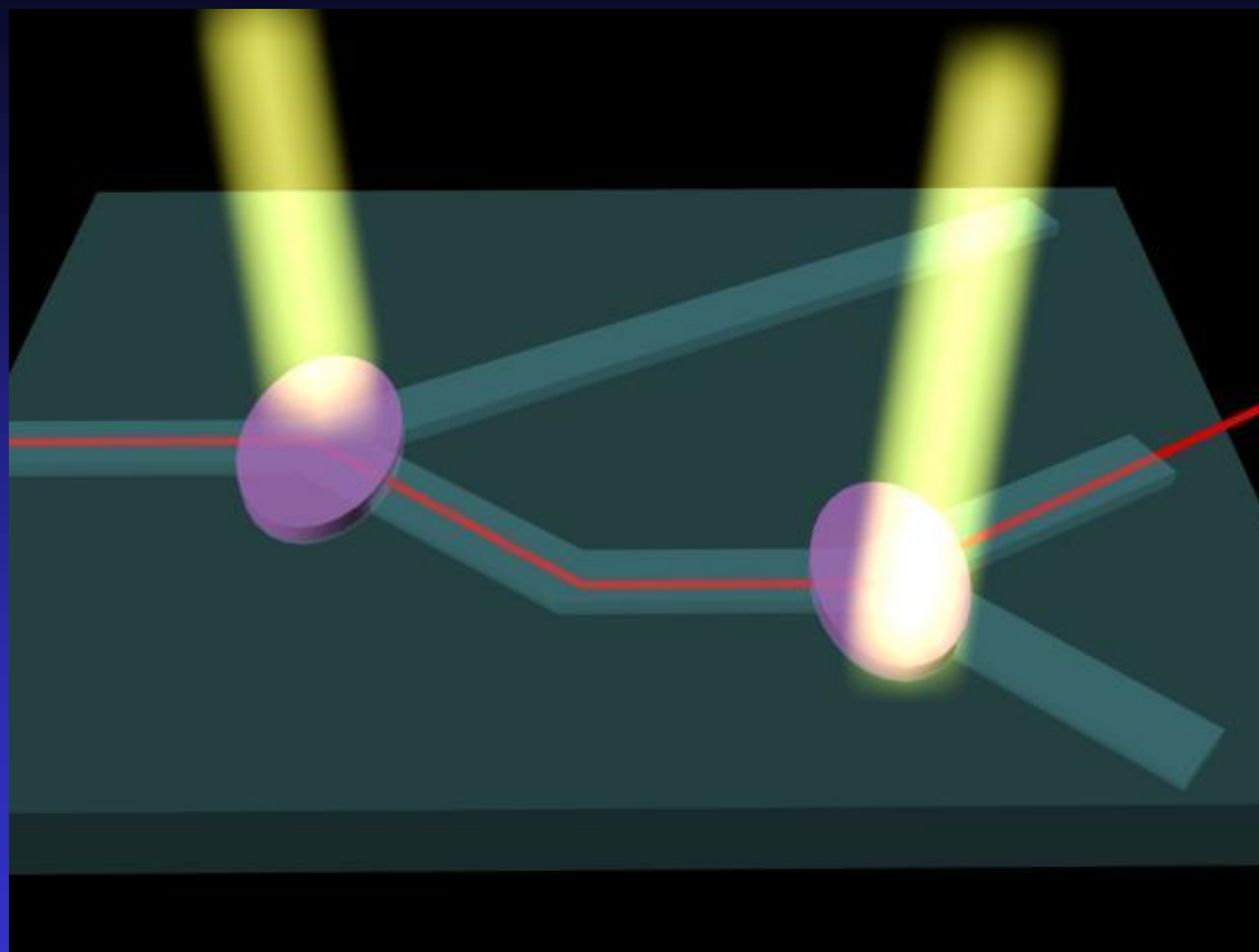
A becsatolt fény intenzitásának szögfüggése

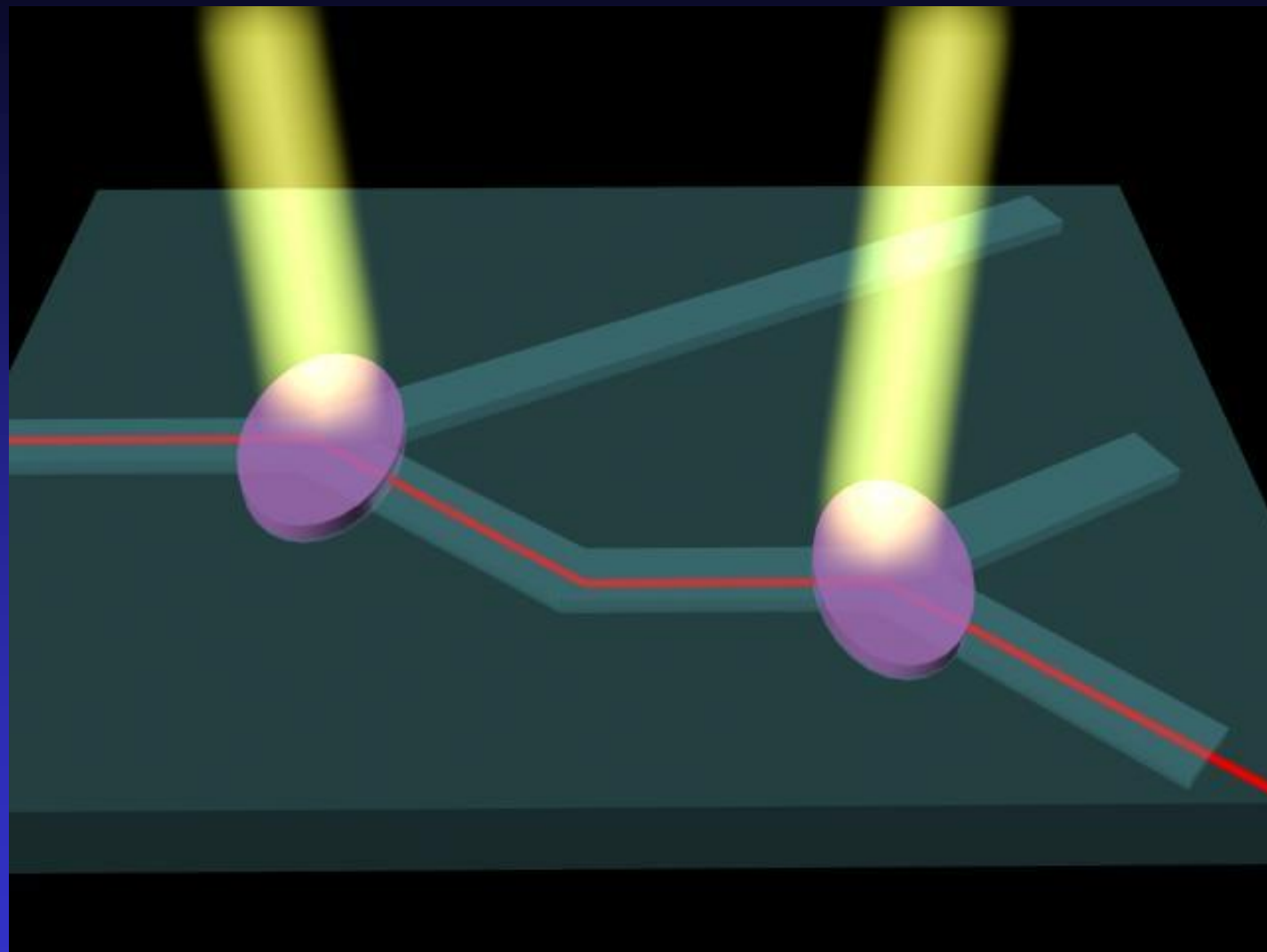


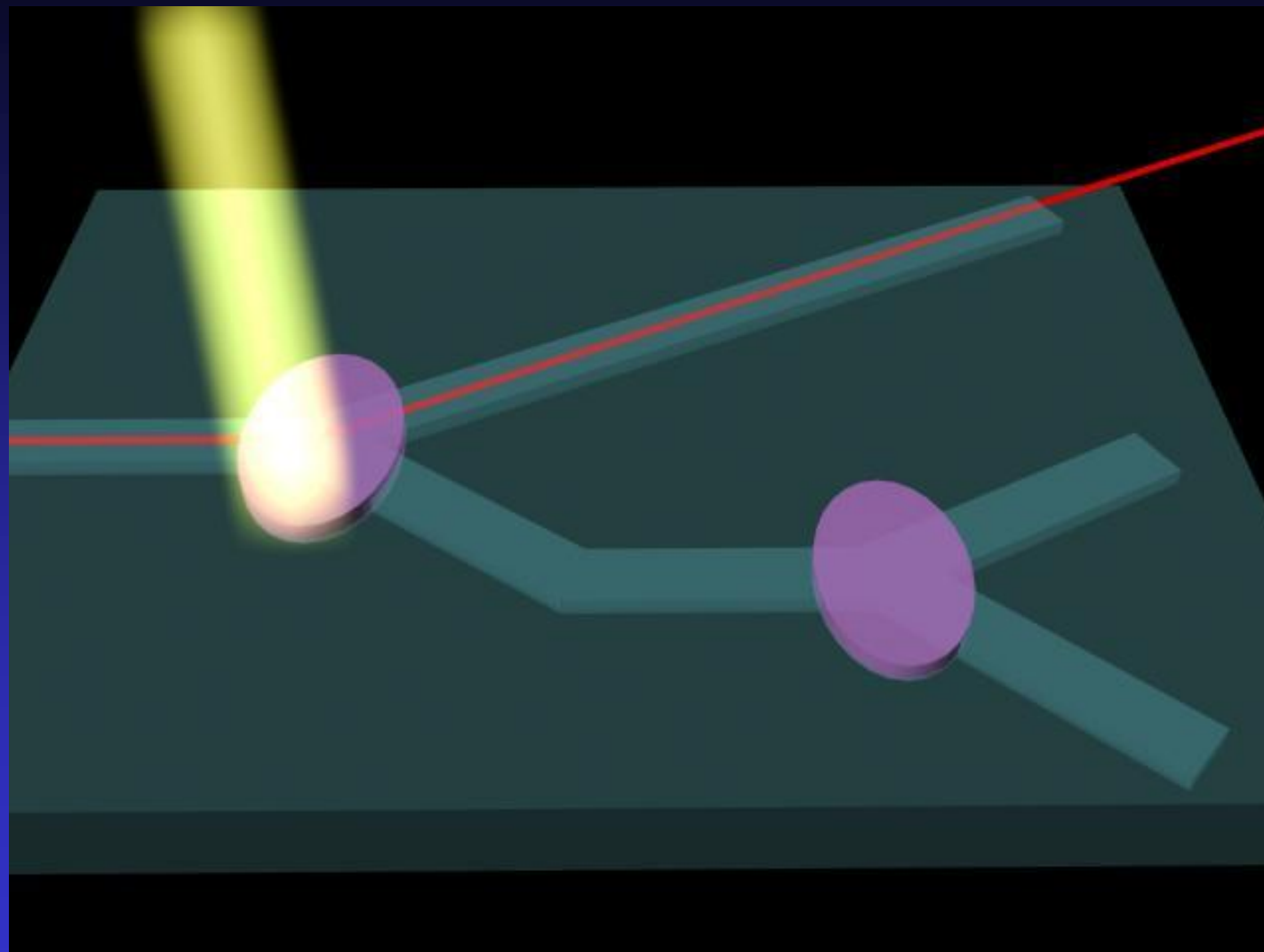
A fényindukált törésmutatóváltozás mérése

A rezonanciacsúcs szögeltolódása



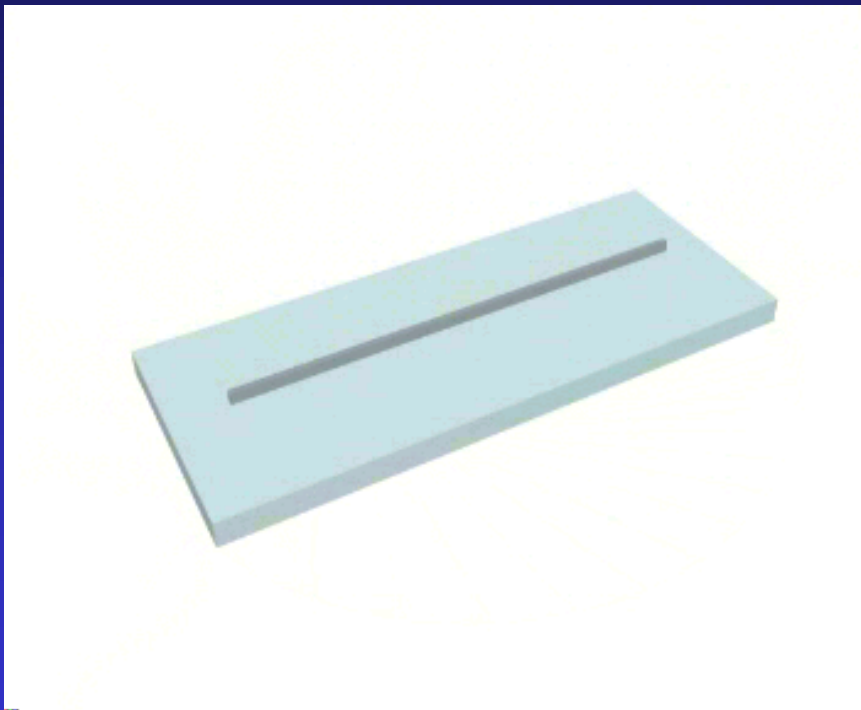




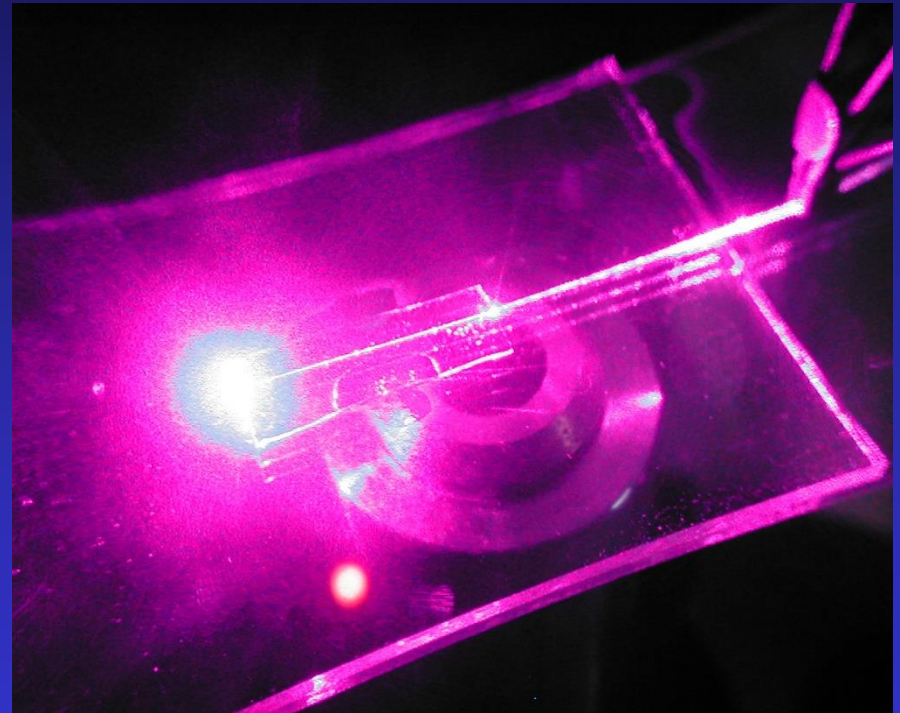


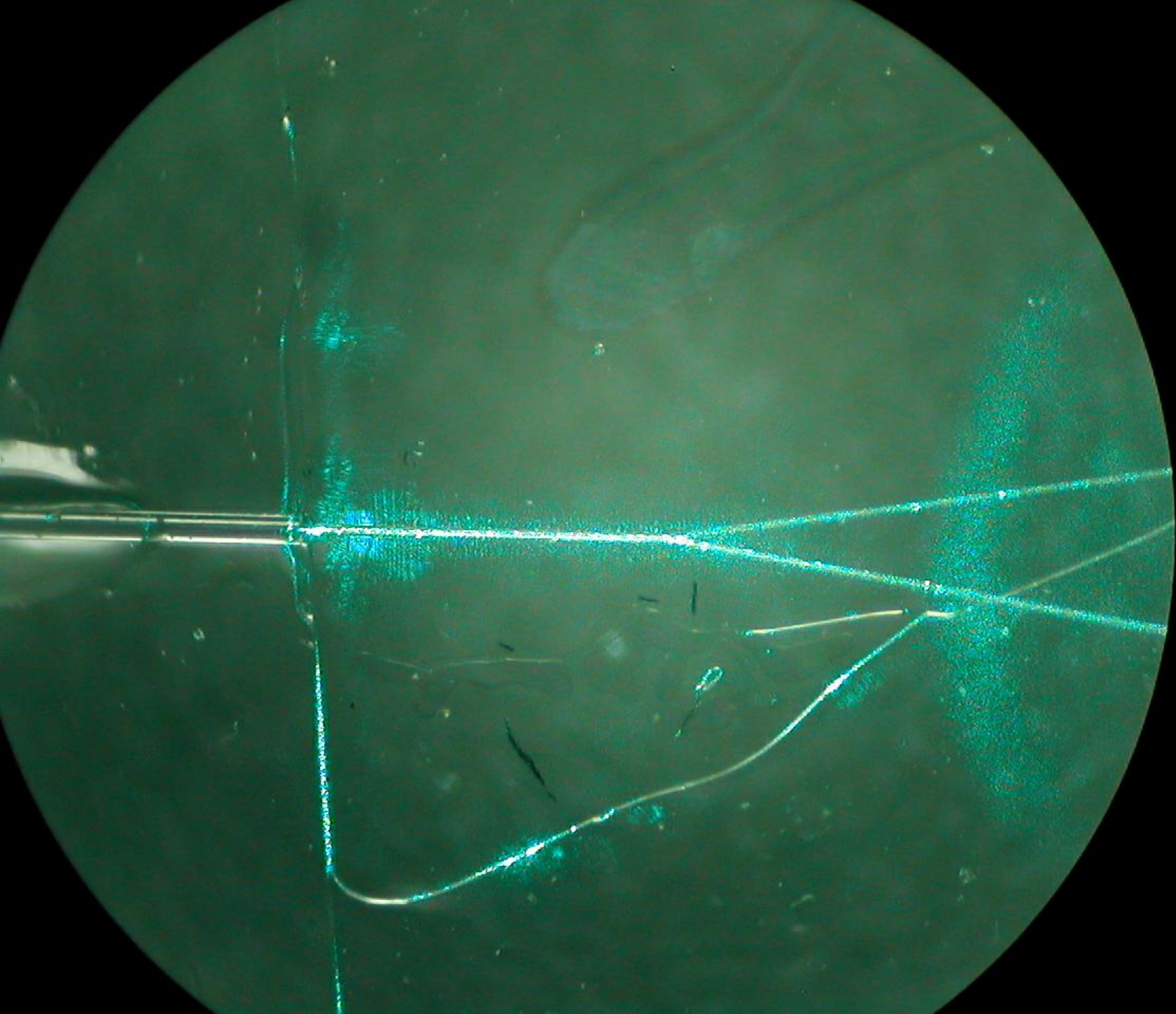
Hullámvezető készítése

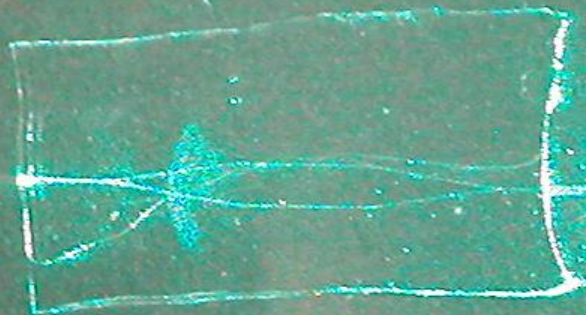
fotopolimerizáció



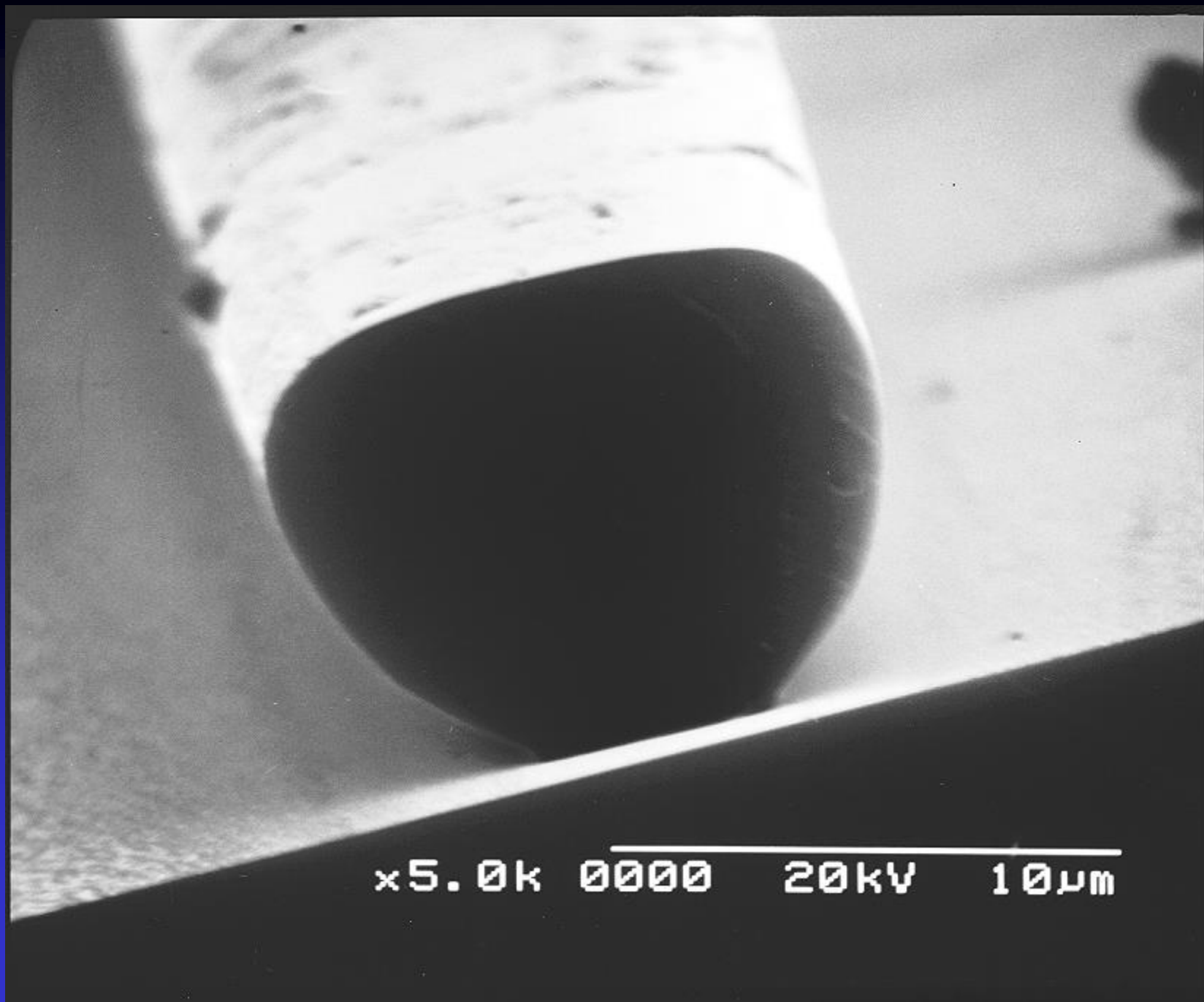
becsatolás



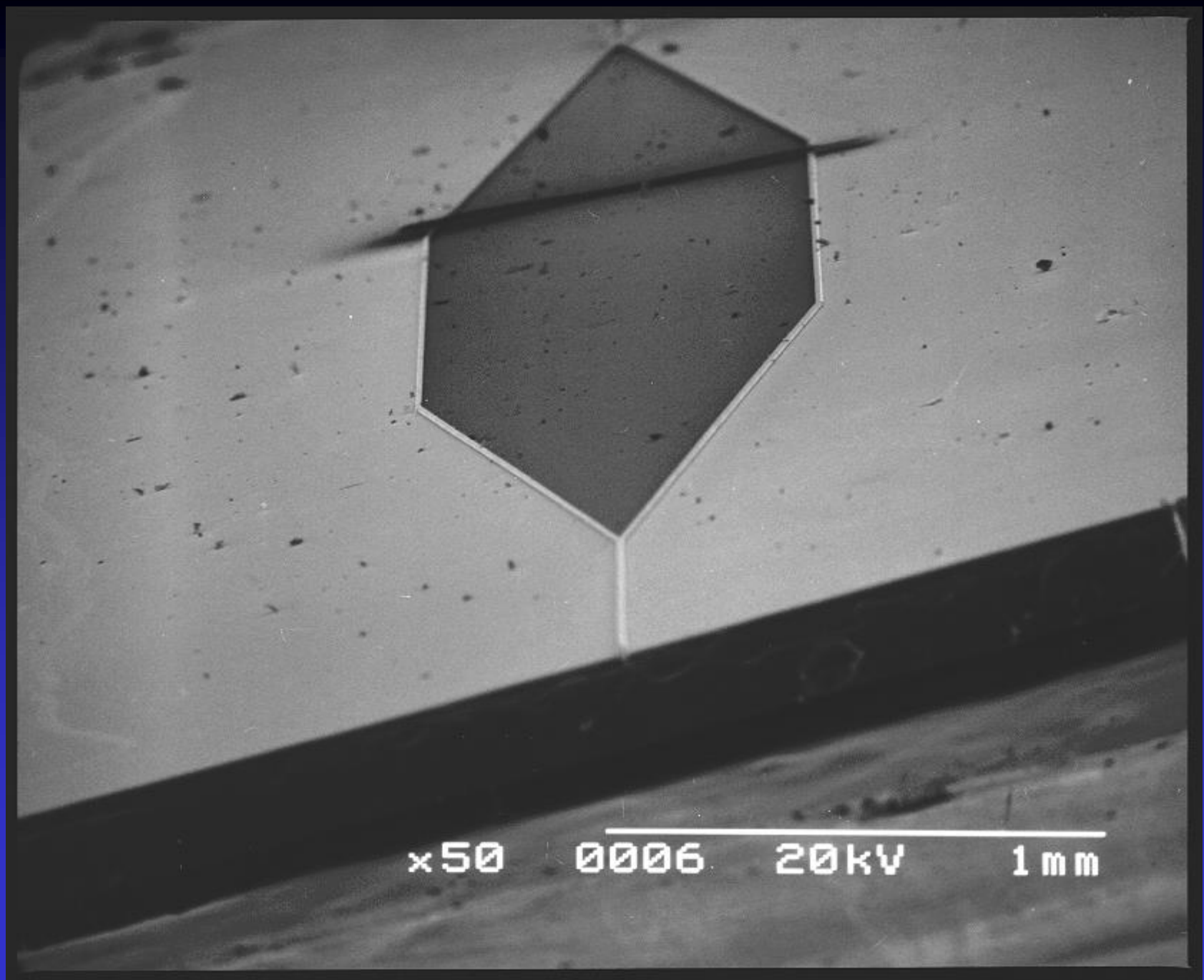




2.

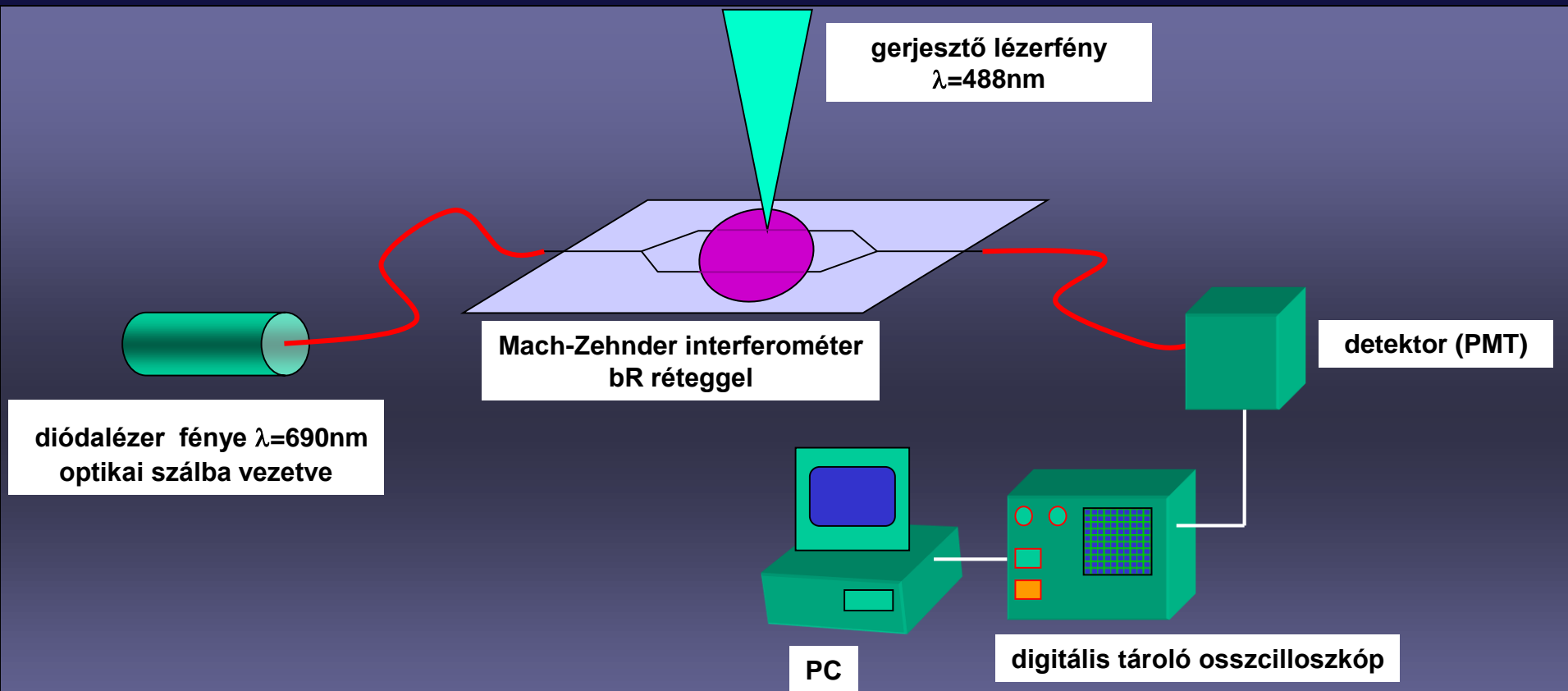


x5.0k 0000 20kV 10μm

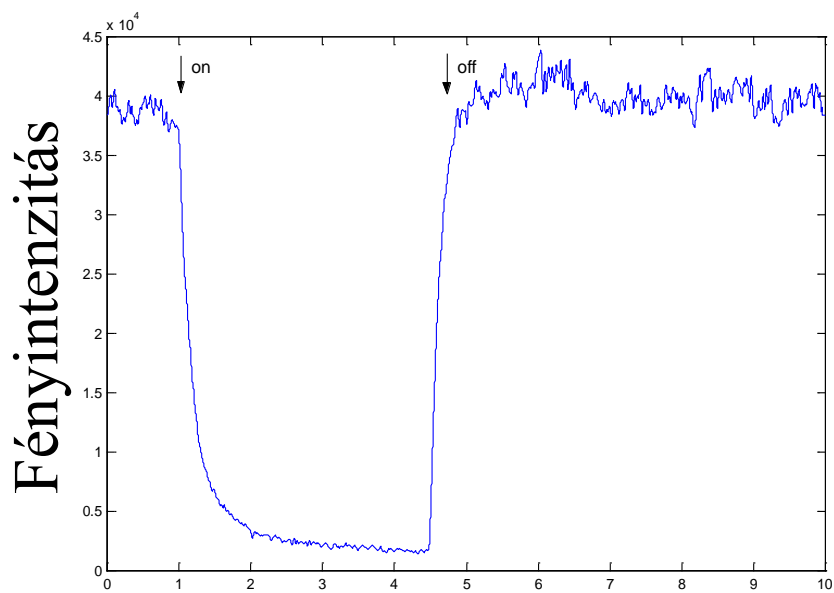


x50 0006 20kV 1mm

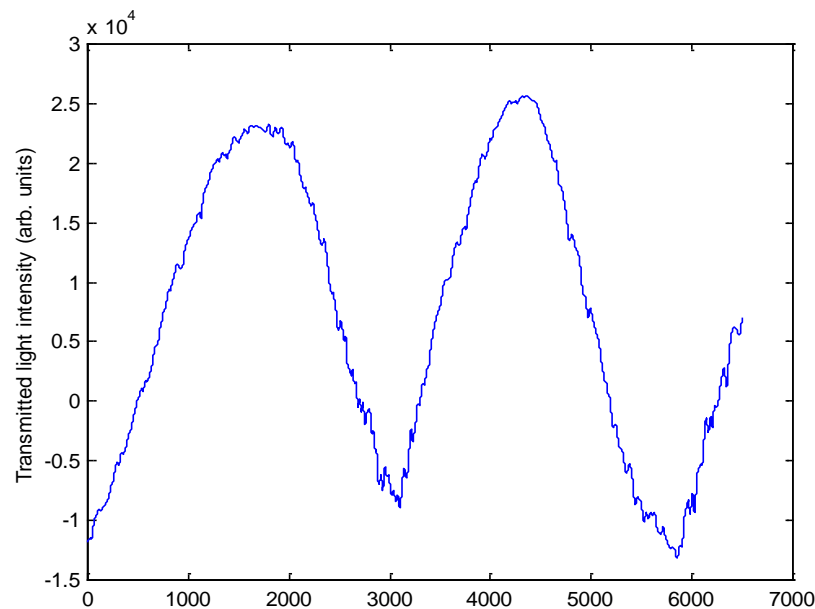
A mérési elrendezés



A kapcsolóeffektus demonstrálása



Idő



Gerjesztő fény int.

The United States of America



The Director of the United States Patent and Trademark Office

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this

United States Patent

Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America for the term set forth below, subject to the payment of maintenance fees as provided by law.

If this application was filed prior to June 8, 1995, the term of this patent is the longer of seventeen years from the date of grant of this patent or twenty years from the earliest effective U.S. filing date of the application, subject to any statutory extension.

If this application was filed on or after June 8, 1995, the term of this patent is twenty years from the U.S. filing date, subject to any statutory extension. If the application contains a specific reference to an earlier filed application or applications under 35 U.S.C. 120, 121 or 365(c), the term of the patent is twenty years from the date on which the earliest application was filed, subject to any statutory extensions.

Jon W. I. Dudas

Director of the United States Patent and Trademark Office



US006956984B2

(12) **United States Patent**
Ormos et al.

(10) **Patent No.:** US 6,956,984 B2
(45) **Date of Patent:** Oct. 18, 2005

(54)	LIGHT DRIVEN, INTEGRATED OPTICAL DEVICE	5,279,932 A *	1/1994	Miyasaka et al.	430/495.1
		5,432,873 A *	7/1995	Hosoya et al.	385/21
		5,470,690 A	11/1995	Lewis et al.	
(75)	Inventors: Pál Ormos, Szeged (HU); András Dér, Szeged (HU); Elmar Klaus Wolff, Witten-Annen (DE); Jeremy J. Ramsden, Bedfordshire (GB)	5,518,858 A	5/1996	Dyukova et al.	
		5,618,654 A *	4/1997	Takei et al.	430/347
		5,757,525 A	5/1998	Rao et al.	
		5,781,330 A *	7/1998	Kolodner et al.	359/273
(73)	Assignee: Biological Research Center of the Hungarian Academy of Sciences, Szeged (HU)	6,284,418 B1 *	9/2001	Trantolo	430/20
		6,366,388 B1 *	4/2002	Hung	359/241
		6,381,072 B1 *	4/2002	Burger	359/622
		6,438,295 B1 *	8/2002	McGarry et al.	385/39
		6,579,673 B2 *	6/2003	McGrath et al.	435/5

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 43 days.

(21) Appl. No.: 10/337,348

(22) Filed: Jan. 7, 2003

(65) **Prior Publication Data**

US 2003/0152358 A1 Aug. 14, 2003

Related U.S. Application Data

(63) Continuation of application No. PCT/HU01/00077, filed on Jul. 9, 2001.

(30) **Foreign Application Priority Data**

Jul. 7, 2000 (HU) 0002588

(51) Int. Cl. G02B 6/26

(52) U.S. Cl. 385/16; 385/145; 385/5; 385/37

(58) Field of Search 385/16, 31, 37, 385/130, 145.5; 422/85.11; 435/5; 359/273

(56) **References Cited**

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4,795,226 A *	1/1989	Bennion et al.	385/12
4,804,834 A	2/1989	Katsura et al.	
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EP	0 254 509 A1	1/1988
EP	0 433 901 A	6/1991
EP	0 532 014 A	3/1993
EP	0 800 106 A2	10/1997
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WO	WO 00/30084 A1	5/2000

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A. Kikineshy et al., "Materials and Devices For Fibre Optic Sensors", XP-0011036746, Multiplex Modules with Integrated Sensors, pp. 181-184, 1996.

(Continued)

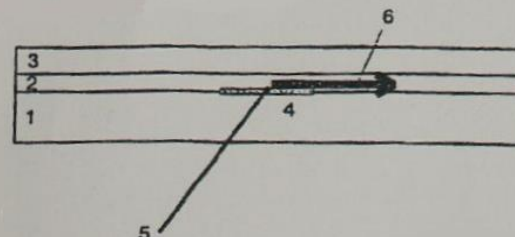
Primary Examiner—Ellen E. Kim

(74) Attorney, Agent, or Firm—Venable LLP; Robert Kinberg

(57) **ABSTRACT**

A fully light-controllable integrated optical switch applicable in a slab geometry configuration includes a waveguide and an ad-medium in contact with the waveguide. The ad-medium comprises a photochromic protein as a material of non-linear optical property, wherein switching of a light propagating in the waveguide is effected by a change of an optical property of the ad-medium caused by a light-induced transition of the photochromic protein from one defined molecular state to another.

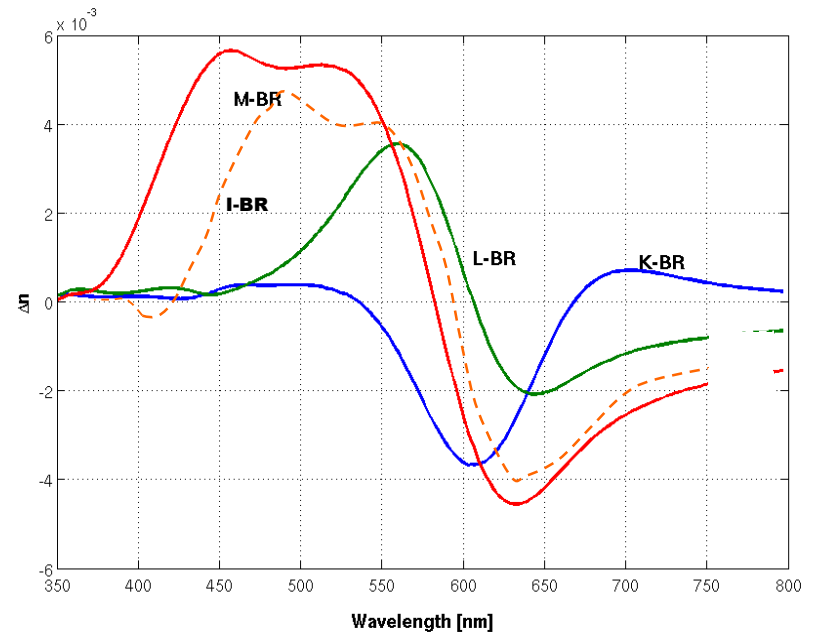
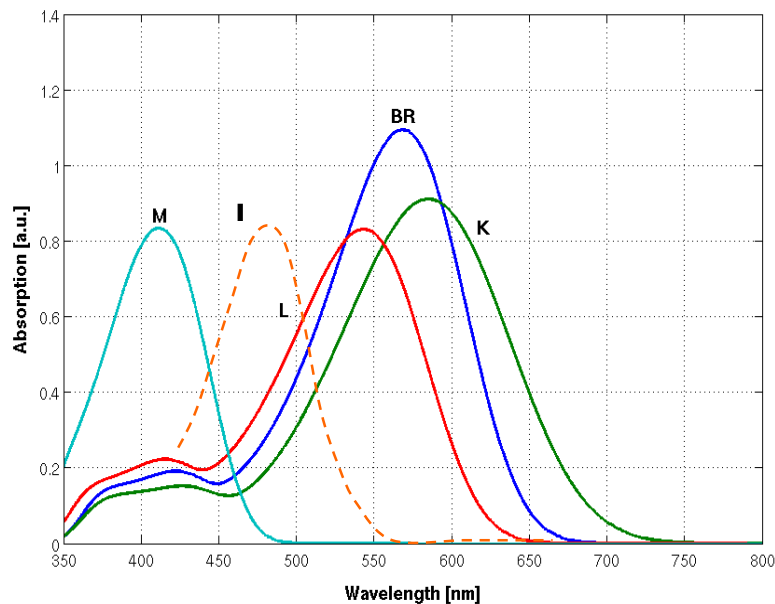
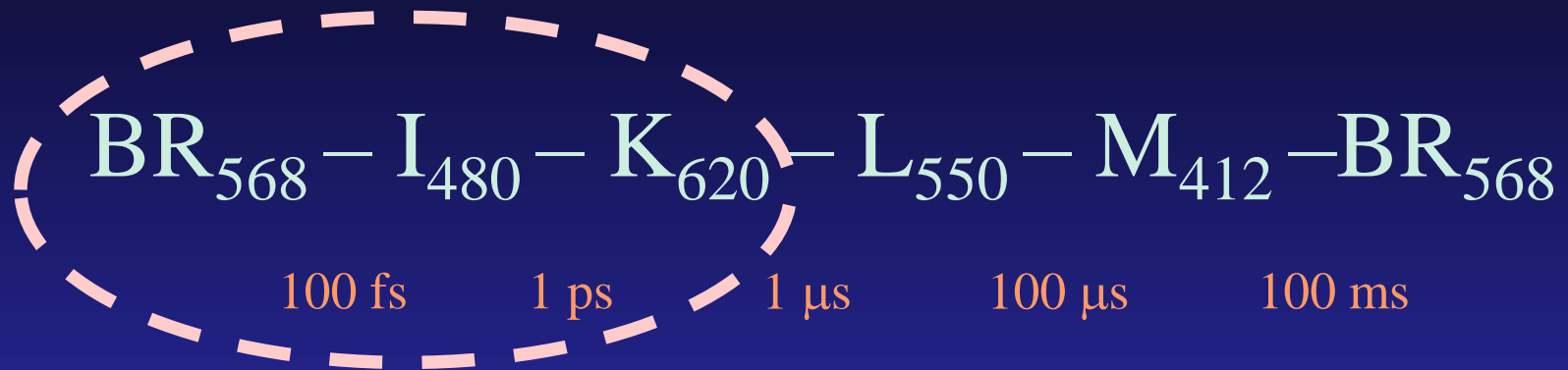
26 Claims, 8 Drawing Sheets



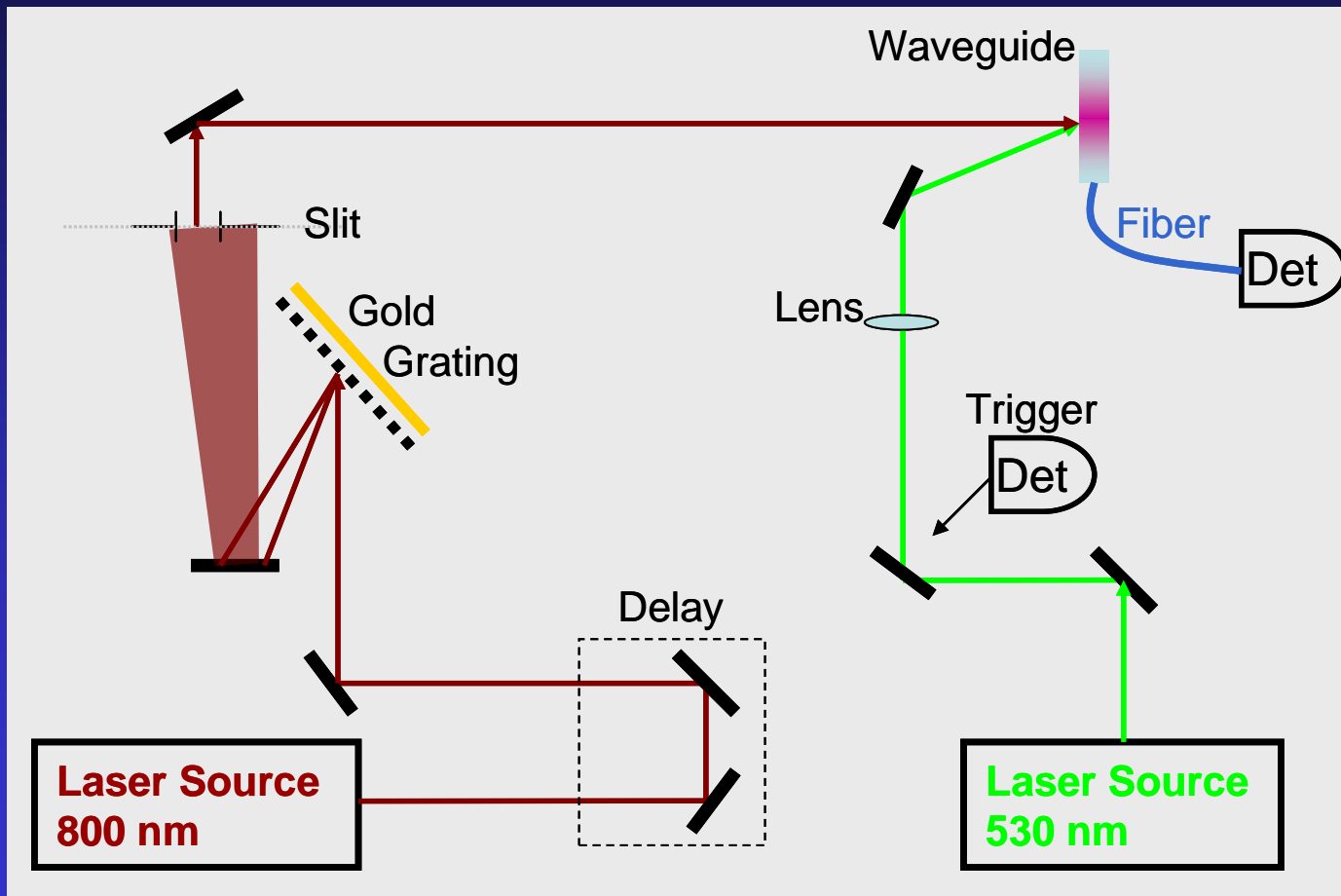
Továbblépési lehetőségek

- A kapcsolási sebesség növelése (más reakciók felhasználása, génszézési módosítások)
- Összetett optikai struktúrák létrehozása
- Szenzorikai alkalmazási lehetőségek (kombinálás mikrofluidikával és mikroelektronikával)

A fotociklus elsődleges lépései



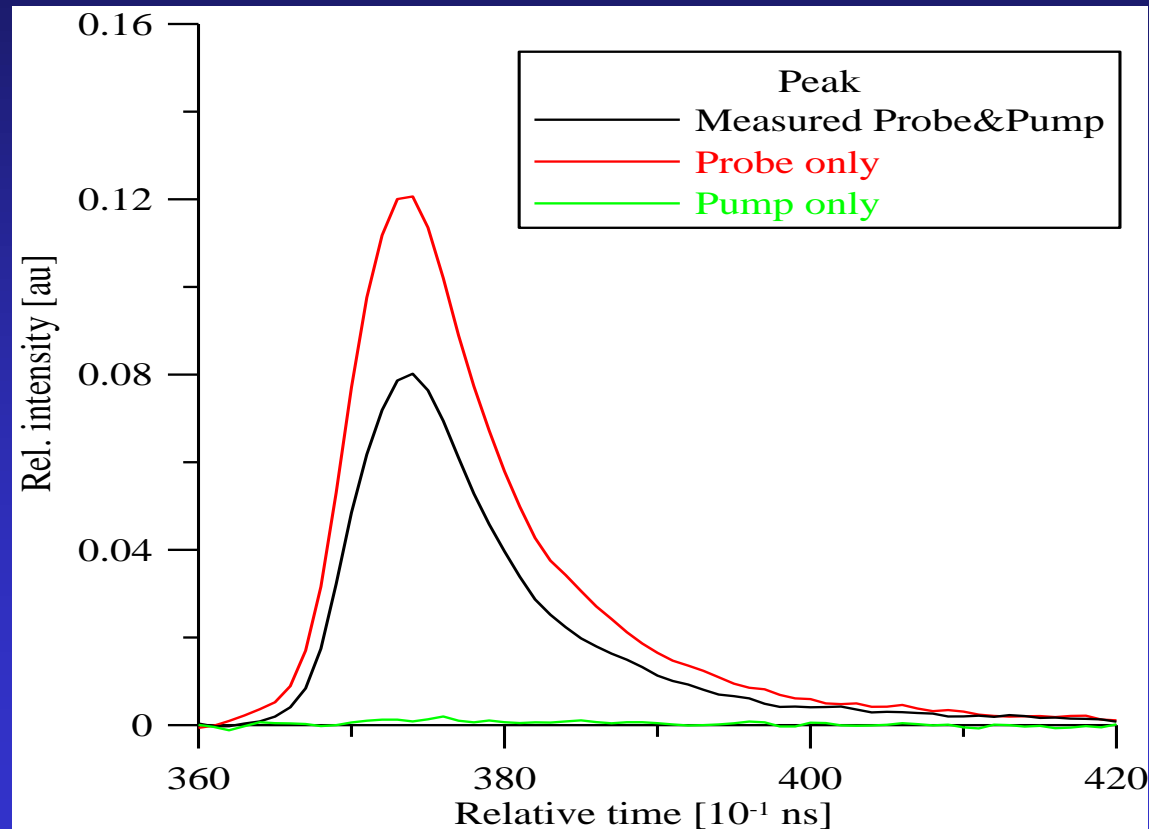
Pumpa-próba elrendezés





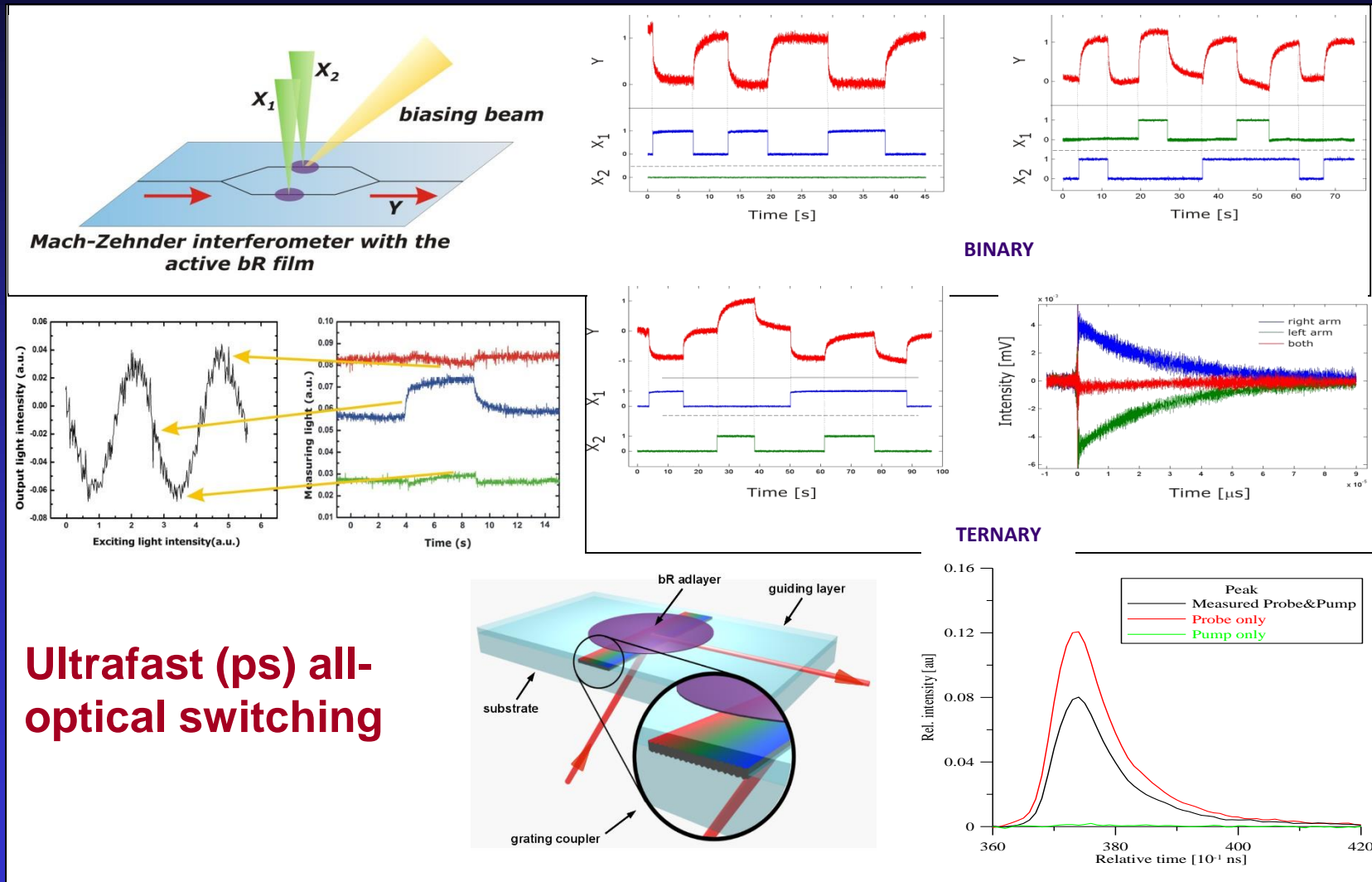
Pump: 530 nm **150 fs**

Proba: 780 nm **3 ps**

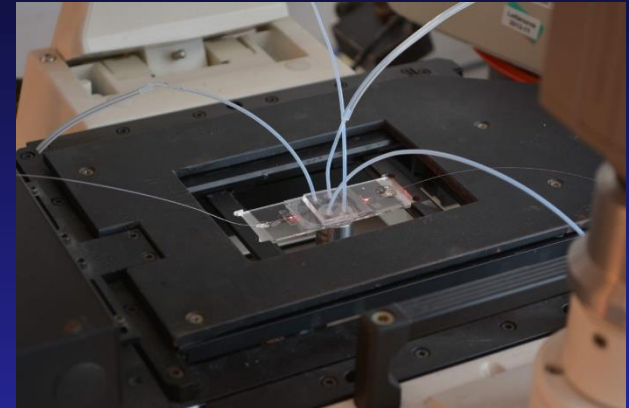
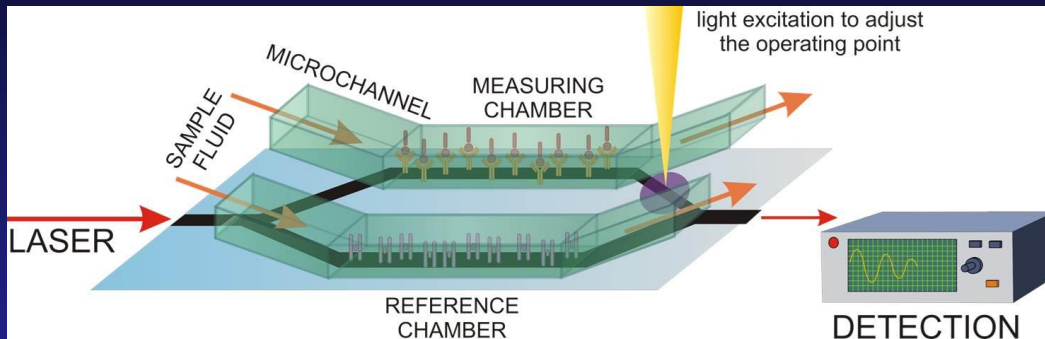


Integrált optikai alkalmazások

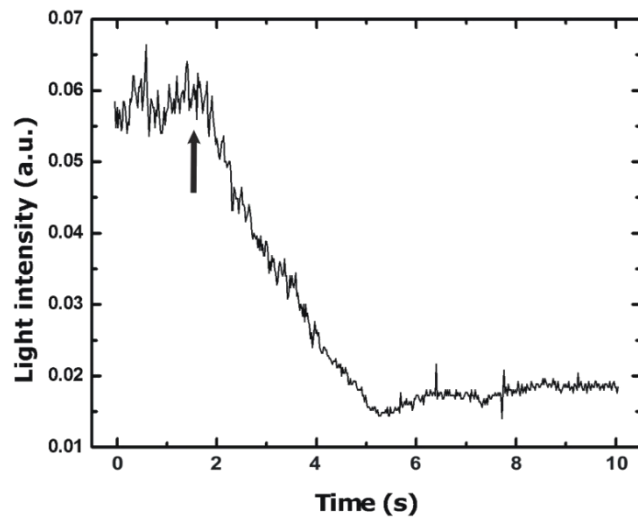
Fotonikai logika



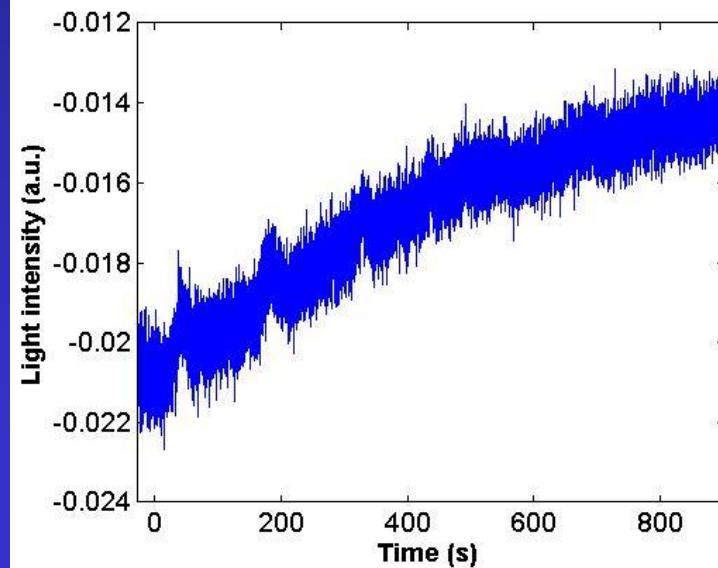
Bioszenzor



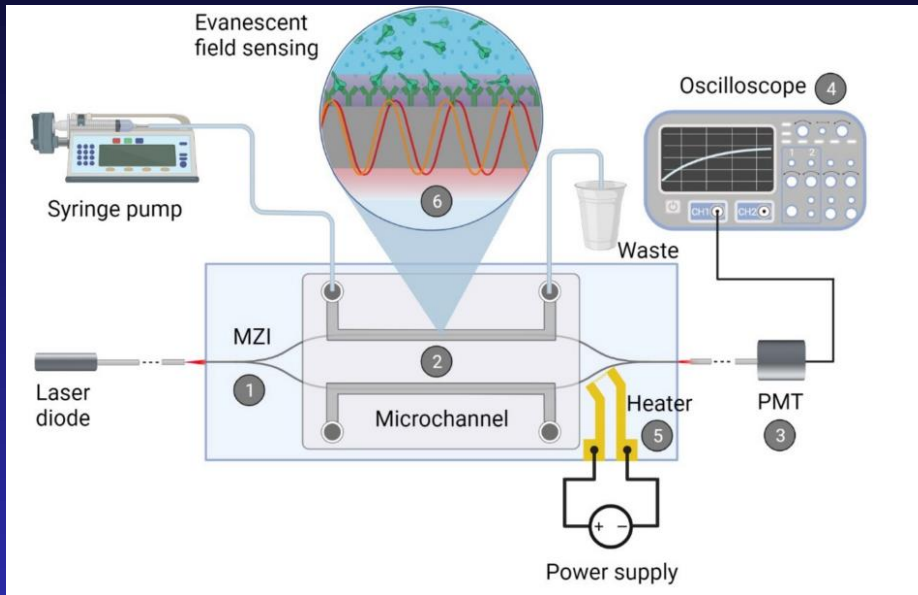
fehérje



baktérium

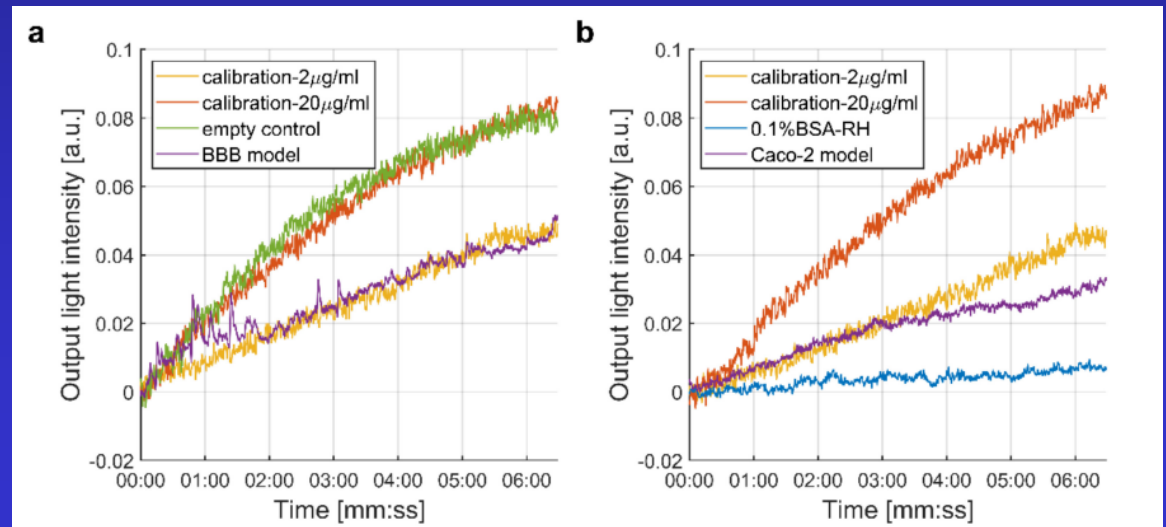


Covid Spike protein



Áthatolás biológiai
gátrendszereken (vér-
agy gát, bélepitélum)

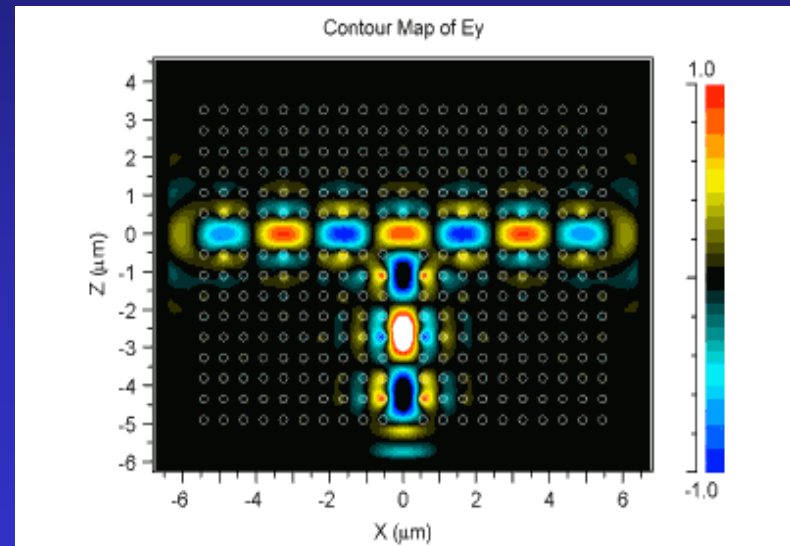
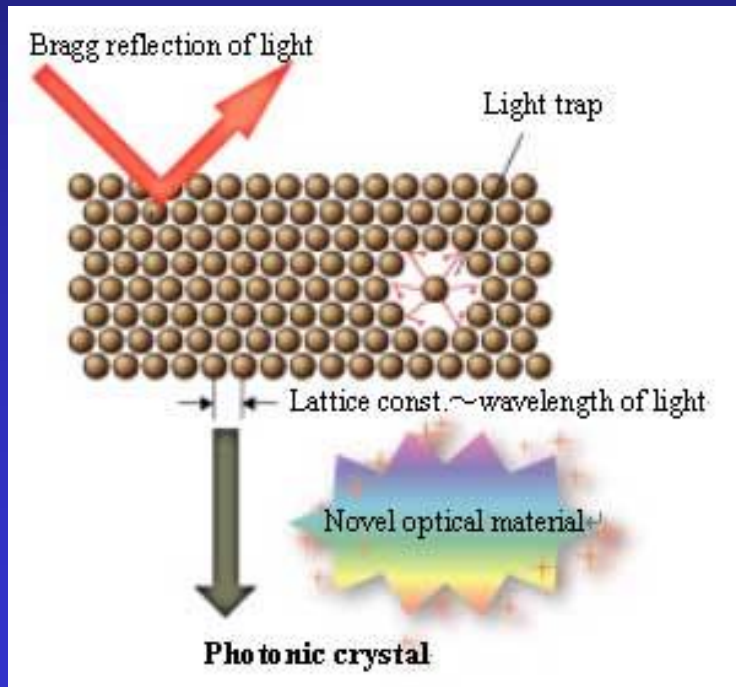
Petrovszki és
mtsi., 2022



Mit hoz a jövő?

Különböző megoldások párhuzamosan -
hibrid struktúrák

Az integrált optika növekvő szerepe (miniaturizálás -
fotonikus kristályok)



Alkalmazások néhány
éven belül