

Федеральное государственное бюджетное образовательное учреждение высшего профессионального образования
САНКТ-ПЕТЕРБУРГСКИЙ ГОСУДАРСТВЕННЫЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

INSTITUTE OF APPLIED MATHEMATICS AND MECHANICS
DEPARTMENT OF THEORETICAL AND APPLIED MECHANICS



M. B. Babenkov

LECTURE 10

Lasers for Medical Applications

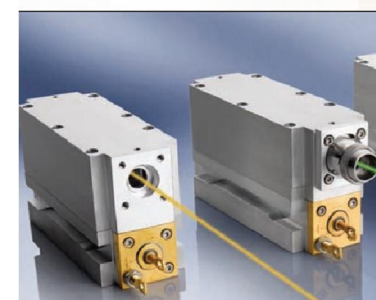
*Lecture slides
for Bachelors of Technical Sciences*

**Санкт-Петербургский государственный политехнический университет
2012**

Санкт-Петербургский государственный политехнический университет, 2012 ©

Popular lasers' types

- Excimer lasers provide pulse energies at the mJ level and beyond.
- Semiconductor Diodes (the wavelength range from 785 To 980 nm, with power levels from multiple Watts to multiple kW)
- Optically Pumped Semiconductor Lasers (uses a semiconductor chip instead of a laser crystal as the laser medium)



Photothermal Reactions

- Laser light absorbed by chromophores in the tissue is converted into heat.
- A typical application is photocoagulation, where the laser light is absorbed by hemoglobin to stop bleeding or to seal blood vessels.
- Another example is thermal ablation when laser light vaporizes tissue water for tissue cutting.
- This interaction requires laser solutions that have high average power and a wavelength that matches the absorption levels of target tissue.

Ophthalmology

- Ophthalmology: excimer laser based solutions for vision correction (LASIK).
- Laser photocoagulation, an important application to treat wet form age related macular degeneration (AMD).
- Yellow light couples effectively with hemoglobin which enables more efficient sealing of blood vessels (photocoagulation).
- The direct modulation capability of OPSL enables us to use pulsing modes proven beneficial in recent applications.

Photochemical Reactions

- Photons absorbed by tissue molecules. Excited molecules can undergo chemical reactions.
- A prominent example is Photodynamic therapy (PDT) where a photosensitive drug is administered. Using specific wavelengths enables applications such as selective photo thermolysis.
- Tattoo removal is an example of this.
- This interaction requires laser solutions that have high average power and a wavelength defined by molecule absorption.

Photoablation

- Laser light is used to break the molecular bonds in the tissue. Key applications include ophthalmology where UV laser light is used for refractive surgery of the cornea;
- As well as in lithotripsy where high energy laser pulses are used to generate plasma and shock waves that can break up kidney stones.
- Typical laser solutions operate in pulsed mode for high peak power and, depending on the type of tissue, have UV to NIR wavelengths.