**Медицинские применения фотоники.**

Совместный семинар IPG Medical, ИРЭ-Полюс, Сколковского института науки и технологий, Фонда Сколково.

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Информация по проезду: http://www.skoltech.ru/o-nas/kontakty/

ТЕЗИСЫ ДОКЛАДОВ (выборочно)

**1. Integration of drug delivery with *in vivo* flow photoacoustic cytometry for cancer theranostics**

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**Speaker**: Dmitry Gorin

The modern medicine requires a new type of drug delivery carriers (DDCs) that will combine functions of in vivo navigation and visualization, carrier degradation, ability to deploy drug in controllable manner, including external triggering and sensing of important biological markers [1]. The nanocomposite microcapsules fabrication approach is promising to create drug carriers with multiple functionality what could be a new generation of drug delivery systems [2]. Physical targeting of drug delivery system can be realized by the gradient of magnetic field [3, 4], optical tweezers approach [5], and cavitation energy [6]. Methods for guiding and visualization of drug delivery systems include: MRI [7] and photoacoustic imaging [8]. Variation of the volume fraction of inorganic nanoparticle led to control the physicochemical properties of nanocomposite microcapsule shells providing the possibility to regulate their sensitivity to external influence (ultrasound, laser, gradient of magnetic field).

Young’s modulus, shell thickness, size of microcapsule, and contact angle of microcapsule shell surface are key parameters to control the sensitivity of microcapsule shell to external triggering such as ultrasound. These parameters are important both for cavitation and possible resonance mechanism of opening of microcapsule shell induced by ultrasound. In case of laser irradiation, parameters such as absorption of inorganic nanoparticles at the maximum wavelength, the size of absorbing centers, thermal conductivity of the surrounding medium, their specific heat capacity and nanoparticles concentration play important role in the microcapsule shell susceptibility. Thus, physical effects on nanocomposite microcapsules are rather complex and should be considered for each particular case of external stimuli either by electromagnetic irradiation or ultrasound.

The goal of this project is to develop integrated magnetic targeted theranostics of circulating tumor cells (CTCs) and primary tumor in vivo using new DDCs as multifunctional, low toxicity, highcontrast agents and photoacoustic flow cytometry setup [9]. We will achieve this goal by integrating (1) intravascular magnetic capturing of CTCs based on their molecular labeling by bioconjugated DDCs; (2) targeted laser ablation of captured CTCs; and (3) laser-based therapy of a primary tumor using the same type of DDCs loaded with anti-tumor drug (doxorubicin [DOX] or photodynamic dye). These technology will benefit on the use high pulse rate picosecond lasers from the IGP. The new nanoparticles as high contrast photoacoustic agent and drug carries has a high clinical potential because they consist of components, which are already approved for use in humans.

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**2. Photonic crystal fibers devices for identification interface of normal/pathological tissues and treatment of pathological tissues during endoscopic diagnostics and operation**

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Photonic crystals and microstructured waveguides can be used for creation of sensors for biomedical applications [1-3], because it is one of the most prospective sensitive elements of fiberoptic sensors of physical and chemical values, the use of which should significantly enhance the ability of traditional fiber biosensors. Visualization of interface of normal/pathological tissues is important task for endoscopic surgery. We are going to apply the photon crystal fibers for some purposes. The first is a liquid biopsy with analyzing biochemical parameters. The second is illumination of tissue by defined wavelength band. The third is analyzing the scattered light for determination of interface of normal/pathological tissues. It will be optimal using IPG lasers as light sources for all cases described above.

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