Recent Progress of Nanotechnology for Bio-sensor and Phototherapy

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Abstract

The use of nano-particles in medicine is one of the important applications of nano-technology including bio-imaging and bio-sensing, drug delivery, cancer cell diagnostics and therapeutics [1]. By changing the shapes of nano-particles from spheres to nanorods, the absorption and scattering resonance wavelengths change from visible to the near infrared (NIR) and therefore offer the advantages of larger optical cross-section and much deeper penetration depth in tissues [2,3]. Recent studies have shown that gold nanorods (GNRs) conjugated to antibodies could be used for selective and efficient photothermal therapy. More recently, Lin et al [4] proposed the use of near IR diode laser system having multiple wavelengths for efficient treatment of cancer tumor. The GNRs coated optical fibers using the excitation of the evanescent wave was also proposed for real time, low-cost, ultrasensitive and multiplexed sensors [5]. The theory behind the above described nano-medical applications is characterized by the selectivity and sensitivity of the associated surface plasmon resonance (SPR) of the incident optical fields. The selectivity of SPR is given by its absorption peak which is red-shifted when the size of nano-sphere increases or when the aspect ratios (R) of the nanorods increases. For sensitive biosensing applications, one should also need a maximal figure of merit (FOM) defined by then ratio of the index sensitivity and the spectral broadening. For cancer therapy applications, pulsed-train technique and optimal laser parameters of a near-IR laser system (custom made by NVI, www.nvi-laser.com) integrated with a real time temperature monitoring are required. The on/off pulsed-train technique allows the surface-temperature of the GNR solution to remain at a preset value without over-heating, whereas higher volume-temperature is also achievable, comparing to that of a single-pulse or CW operation. The pulsed-train technique when operated at optimal laser parameters provides a great potential for efficient laser therapy of large size cancer tumors. In addition to the GNRs, I will also present recent progress using nanoslit array for chip-based biosensor [6].

Key words: nanophotonics, biosensor, surface plasmon resonance, gold nanorods, nanoslit

Reference

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