

Shock Wave Based Cell Transfection and Fluorescent Organosilicate Nanoparticles for Targeted Drug Delivery

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Nanotechnology is a multidisciplinary field that has applications in life sciences, alternative energy, national defense, and electronics. In the field of medicine, nanotechnology may enable intelligent drug delivery using multifunctional nanoparticles. Here, we show two technologies that are envisioned to work in tandem to enable targeted detection and treatment. First, a shock wave generator used for cell transfection and drug/particle delivery is presented. Then, fluorescent dye/drug encapsulated organosilicate nanoparticles (OSNP) with functionalized surfaces for targeted delivery are described. The shock wave generator has been successfully used to deliver various molecules and nanoparticle to inside of the cells with very high efficiency and low cell damage. These include dextran (77 kDa), naked plasmid, and dye-doped organosilicate nanoparticles into several types of cells lines including T47-D, HL-60, and MCF-7, and also into tissues including entire chicken heart (at developmental stage 20-30) and chicken spinal cord. Dye doped organosilicate nanoparticle surfaces conjugated to antibodies have been successfully used in immunofluorescence assays. Close examination of the nanostructure of these particles reveal its unique nanoporous structure. These nanoparticles are currently under investigation for drug encapsulation and sustained release. The implication of these technologies is that the OSNP can be used as targeted drug carriers, and the shock wave generator can be used to deliver the OSNP into cells to which the particles attach. The research on shock wave micro-transfector system has been funded by the National Science Foundation Grant Opportunities for Academic Liason with Industries program.