ICASH-KEYNOTE

SYNTHESIS OF NANOMATERIALS AND ITS BIOMEDICAL APPLICATIONS FOR HUMAN'S HEALTH

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EXTENDED ABSTRACT

Despite better healthcare system, there are increasing number of people suffering from various diseases such as cancers, cardiovascular diseases, diabetes, infectious diseases, Alzheimer's, Pakinson's etc. The disease is not only effect to the patient life, but also create the burden on the families and caretakers in term of personal and financial situations. Moreover, the poor health population can cause negative impact to the society for example problems in health care system management, reduction of workers due to illness and early retirement, reduction of productivity of business sectors, and reduction of economic growth of the country. Therefore, the society requires new technology to overcome this health challenge by improvement of protection, prevention, and treatment of the common diseases.

The emerging 21st century technology called "nanotechnology" has the potential to revolutionize human health. It is interdisciplinary involved the combination of knowledge in chemistry, biology, materials, medicine, pharmacy and engineering. This promising nanotechnology has potential to provide higher sensitivity, accuracy, safety and effectiveness but more affordable healthcare tools than the traditional methods. The definition of nanometerials used in nanotechnology was given by European Union and National Nanotechnology Initiative as a materials with the size range between 1-100 nanometer. Due to its unique properties and small size, the development of nanomaterial is attractive in the area of diagnosis and treatment of several diseases.

High surface area and optical properties of nanomaterials allow the nanoparticles react with reactants or bio-substances at significant lower amount but provide higher optical signals than traditional approaches. These unique properties can lead to the discovery of sensitive and simple detection tools where it can detect even small biochemical changes in cellular level before it further develops to serious diseases. In addition, it can increase awareness for consumers to protect harmful chemicals that might contaminate in daily consumable products. For example the designing of quantum dots, highly fluorescent semiconductor nanocrystals, showed high sensitivity to detect benzoic acid and parabens which are food preservatives that some studies showed association with the risk of cancers.

The nanoparticles have potential not only for detection, but also for diagnosis applications. The nanomaterials with high contrast properties, biocompatibility and stability in biological systems can be used as an alternative method for biopsy. Even though biopsy is useful technique for diagnosis certain diseases by removal of tissue samples from the body, it can lead to other complications, high cost, and patient discomfort. The utilization of nanomaterials offers the possibilities of real-time monitoring of biological substances without requirement of invasive technique and still provide the information for early

diagnosis or tracking the progression of disease. This methods would benefit to reduction of the surgery complications, recovering time, anxiety and the medical expense for patients.

Not only the development of materials for early diagnosis is essential for health improvement, the effective treatment with lower side-effect is also desirable. There are several drugs that highly effective, however, its instability and hydrophobicity properties can limit their bioavailability to the target sites. Using higher drug dose to increase the bioavailability is an alternative approach but it might lead to cytotoxicity and cause various side effects. Whereas using lower-dose of drug administration to compensate the toxicity level, requires higher frequency of the drug taking. Since nanoparticles have both hydrophobic and hydrophilic properties, therefore it can be used to encapsulate drugs, increase its bioavailability, and penetration into the cells.

Poly(lactide-co-glycolic acid) is one of the biodegradable and biocompatible polymer that widely studied for drug delivery carrier development. These polymeric nanoparticles can reduce the toxicity of the drug by control the rate of drug release to low toxicity level but still maintain the effectiveness of drug treatment. These control and sustain release properties of nanomaterials can be optimized from synthesis methods to obtain the desirable drug carriers. In addition, the free drugs can cause adverse effects from off-target which damage other healthy cells or tissues and cause various side-effects. Therefore, the drug carriers with ability to deliver the cargoes to specific cells and tissues are preferable. Thanks to various available surface functionalities of nanomaterials, the specific targeting of the nanocarriers can be achieved by functionalization with specific ligands, antigens, antibodies etc. to the target site e.g. cancer region, or inflamed organ. Therefore, tunable properties of nanoparticles have potential to develop as a smart drug delivery systems which can reduce unpleasant side effects from high toxicity and non-specificity of the drugs to the patients.

Even though, the applications of nanomaterials in medical fields are promising and give us a light on the improvement of human health and the quality of life, the safety of nanomaterials need to be validated before applying to human. There are still several steps ahead to improve the nanomaterials in medical applications, with the hope for the bright future, researchers worldwide are working toward the goal that would benefit to improve human health at individual and global levels.

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