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Shahrom Mahmud

Universiti Sains Malaysia, Malaysia

Biological photo-toxicity of nanomaterials towards unwanted living cells

Potential applications of nanomaterials in biomedicine are based on their biocompatibility and inherent nature of selective cytotoxicity against unwanted living cells such as hazardous bacteria, cancer cells and pathogenic fungi, whereby healthy human cells should not be harmed. In order to protect human cells from being harmed, most in-vitro studies reported that uncoated nanomaterial concentration of less than 5 mM is the required concentration that can cause major cell injury towards hazardous bacteria. In recent years, there has been great interest in using light-sensitive nanomaterials with unique optical properties that offers much better toxicity efficacy under a specific light wavelength irradiation at a low applied power. This photo-toxicity effect offers a special flexibility and selectivity by causing a serious cell damage only when the nanomaterials are localized in the unwanted living cells and then illuminated with a suitable wavelength without affecting surrounding normal tissue. Exposing light-sensitive nanomaterials under localized light irradiation with specified wavelengths in the biological micro-environment can induce strong photo-catalysis that produces immense photo-generated charges (negative electrons and positive holes). These photo-generated charges promote a series of photo-chemical reactions that generate a highly cytotoxic reactive oxygen species (ROS) that can kill the targeted unwanted cells. ROS and dissolved metals ions are known to cause cell injury including destruction of cell integrity, damage of cell wall/membrane and destruction of cellular components (lipids, DNA and proteins). The present session will cover a review of photo-toxicity of nanomaterials, probable toxicity mechanisms and future trends, and some sharing of a research experience on animal and human studies relating to light sensitive-ZnO nanomaterials.

Speaker Biography

Shahrom Mahmud obtained a BSc. degree in Materials/Ceramic Engineering from Iowa State University (Dec 1986) and MSc (2004) & Ph.D. (2008) degrees from Universiti Sains Malaysia. Having worked as an Engineer for a decade in MNCs (Thomson, Sumitomo, Nippon Steel, Acme, Rolnic, IBM), Mahmud was involved in the manufacturing, development and research of many products (about 1 billion electronic components & ceramics) including magnetic ferrite cores, MW filters, metal oxide varistors, CERDIP alumina substrates and ceramic tiles. As an academic, he has taught over 20 subjects on mathematics, science and engineering in many offshore degree programmes (Aussie, UK, American) and USM programmes (BSc, MSc, Ph.D.). His research areas are transdisciplinary involving nanomaterials, optoelectronics, bacteriology, anti-cancer, bio-composites and nano-fertilizers. Apart from publishing over 100 publications, Mahmud has received about two dozen awards in research & innovation and recently obtained one single-inventor patent. His research team, Zinc Oxide Research & Innovation (ZORI), has been actively engaging in transdisciplinary research in that ZORI team has published about 80 ISI papers with total IF>110 and produced three innovative products that won three gold medals. For six consecutive years, he has served as the Chief Judge of one international innovation competition.

e: shahromx@usm.my