PROGRESS, CHALLENGES, AND FUTURE OF NANOMEDICINE IN MEDICAL AND BIOMEDICAL RESEARCH

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Abstract

The past decade has witnessed steady growth in investment in nanotechnology by both government and industry around the world. Biomedical research has been identified as one of the fields that can greatly benefit from the advancement in nanotech. In particular, nanomedicine — an offshoot of nanotech that refers to highly specific medical intervention at the nanoscale for curing disease and repairing damaged tissues such as bone, muscle or nerve — is emerging as an exciting playground not just for biomedical researchers but also for material scientists.

Nanotherapeutics exhibit unique advantages in clinical outcomes compared with conventional small molecular drugs. The past three decades have seen intensive research in the field of nanomedicine, leading to a large number of nanomedical products commercialized globally as well as a pipeline of candidates being translated. However, the development of nanomedicine still faces poor efficacy in some applications. The key to advance the field is a deep understanding of the current barriers, addressable challenges, and future demands. In this lecture, firstly, i present an overview of the more conventional nanotherapeutics (Figure 1) that have been widely investigated so far. This is accompanied by a discussion of the next-generation precision and high-efficient nanotherapeutics, exemplified by functional nanodrugs with enhanced passive targeting, active targeting, and stimuli responsiveness. Next, I hope to emphasize the importance of translating nanomedicine research from bench to bed, detailing issues of safety evaluation, biological fate, manufacturing, cost, and regulatory hurdles. Finally, I shall provide our perspectives on the challenges and opportunities awaiting scientists to advance this exciting field.

However, our local contributions in the field of transdermal drug delivery which has led to inventions shall not be left out.

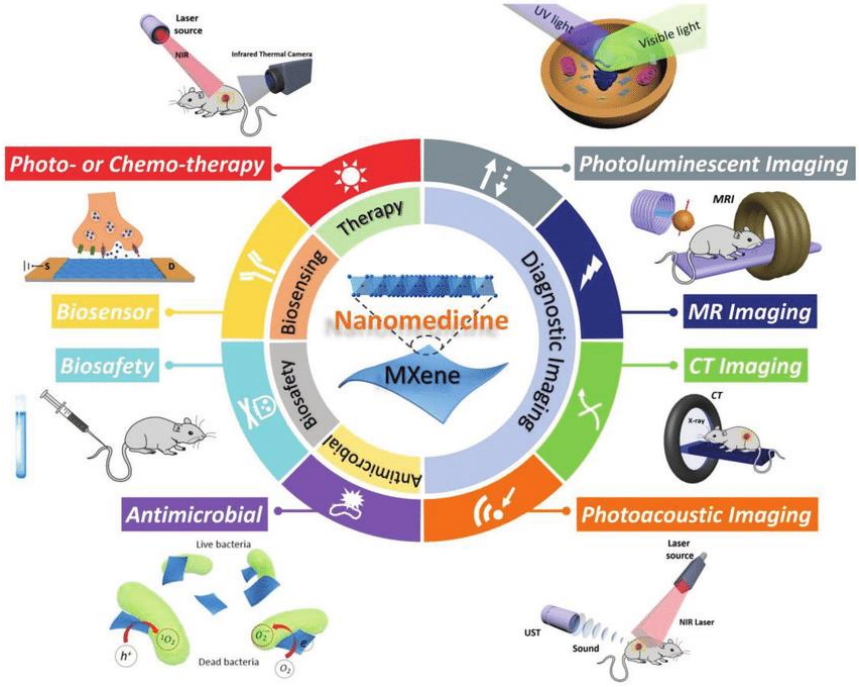

Figure 1: General overview of nanotherapeutics concepts

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CITATION

Enock Olugbenga Oladepo DARE is presently the first Professor of Nanotechnology in Nigeria. He is a seasoned chemist, distinguished scholar and researcher of high repute. He holds a Ph.D in Chemistry of the University of Ilorin, Nigeria and Advanced Research Diploma in Chemical Engineering of Tokyo Institute of Technology, Japan. A postdoctoral training at Princeton University, NJ, USA. Professor Dare is an outstanding international scholar and widely travelled to all continents of the world through international cooperation, having visited more than 30 different countries. He is a UNESCO and MONBUSHO fellow (Japan); USAMI and FULBRIGHT fellow (Princeton University, USA); Taiwanese National Science Foundation fellow (Taiwan); ICTP, Trieste, Italy e.t.c. To crown it all, he recently got the world most prestigious Alexander von Humboldt (AvH) – Georg Forster fellowship tenable at Regensburg University (Germany). In recognition of his excellent performance in Germany and as re-integration process, Humboldt further accorded him a "return fellowship" while in Nigeria in the year 2020 to advance his research mission in Forensic, Sensor and Bioimaging. Prof. Dare is at the forefront of Nanotechnology research in Africa. He remain a major player in the Nigeria Nanotechnology Initiatives of 2006 that brought Nanotechnology into limelight in Nigeria, and which was administratively supported by the former DG, NASENI, Prof. O. Adewoye. This prompted his nationally appointment to train scientists and industrialists the theoretical and practical perspective of nanotechnology in 2011. He has made excellent research output in hybrid nanocomposites based on POSS, nanoporous membrane technology, transdermal drug delivery, nanobimetallic for sensor and catalysis, green nanotechnology, nanobiotechnology, food science and technology, forensic e.t.c. His most current research lies on "nano-enabled materials for anti-counterfeiting, fingerprinting for criminality detection. Furthermore, he is the brain behind the invention of a point-of-use nanoporous water purification technology that accorded him a national award as the 2nd best at the National Universities Research and Development Fair (NURESDEF 2012). It was on this note that Prof. Dare feature occasionally in NUC-sponsored "voyage of discovery" on AIT and NTA as he demonstrate the new technology. It is worth of note that several other awards, grants and commendations are to his credit. He was "Innovation and Invention" awardee of NASENI. The governing council of the Federal University of Agriculture, Abeokuta commended him "for breaking new grounds in Chemistry" in the year 2014. He is the author/co-author of over 100 scientific publications (patents inclusive); the patents are inventives which address crude oil spill clean-up and and nanoemulsified transdermal drug treating diabetes II. He has given more than 30 invited lectures (plenary and keynotes) at various conferences world-wide. Professor Dare has produced 10 Doctors (Ph.Ds), some of which has gained tenure at prestigious institutions nationally and internationally. Administratively, he was former Acting Director of Academic Planning, Federal University, Lafia. As well, he was former Head of Department of Chemistry, FUNAAB.