Journal of Medicinal Chemistry

Perspective

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Carbon Nanotubes in Biomedical Applications: Factors, Mechanisms, and Remedies of Toxicity

Miniperspective

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J. Med. Chem., **2016**, *59* (18), pp 8149–8167
DOI: 10.1021/acs.jmedchem.5b01770
Publication Date (Web): May 4, 2016

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Biography
Reem Alshehri received her B.Sc. and M.Sc. in Biochemistry from King Abdulaziz University, Jeddah, Saudi Arabia. Her research area concentrated on the mechanisms of mercuric compound toxicity and their role in initiating of oxidative stress, autoimmunity, and response of autistics to organic forms of mercury. Her research interests include molecular mechanisms contributing to autism and neuroscience and using nanotechnology tools in the treatment and diagnosis of neurodegenerative diseases.

Biography
Asad Muhammad Ilyas graduated with a B.Sc. in Biology. He received his Master's degree from University of Skovde, Sweden, with a major in Molecular Biology in 2010. He completed his Ph.D. in Biochemistry with a major in Molecular Biology from King Abdulaziz University in 2016. His research focuses on targeting multiple signaling pathways for the treatment of acute myeloid leukemia, including interventions using nanotechnology. In addition, his research focuses on studying the mechanism of cancer related genes in the development of leukemic hematopoiesis.

Biography
Anwarul Hasan, Ph.D., P.Eng., is an Assistant Professor of Biomedical Engineering and Department of Mechanical Engineering at the American University of Beirut, Lebanon, and the Department of Mechanical and Industrial Engineering at Qatar University, Qatar. He is also a visiting Assistant Professor at the Harvard Medical School (HMS) in Cambridge, MA, U.S. Earlier, Dr. Hasan worked in industry during 2010–2011 and was a National Science and Engineering Research Council of Canada (NSERC) Fellow at Harvard and Massachusetts Institute of Technology during 2012–2013. Dr. Hasan obtained his Ph.D. from University of Alberta, Canada, in 2010. His current research interests are in the areas of biomaterials, biomechanics, and tissue engineering, particularly for cardiovascular, bone, and neural applications.

Biography
Adnan Arnaout is a fourth year mechanical engineering student at the American University of Beirut, minoring in biomedical engineering, with special interest in tissue engineering. He is an undergraduate researcher at the Nano Micro-Technologies and Tissue Engineering Lab at the American University of Beirut. His research focuses on developing hydrogels for tissue engineering, as well as microfluidics.

Biography
Farid Ahmed completed his Ph.D. in Human Biology from the Ludwig Maximilians University, Munich, Germany, in 2006. He performed his postdoctoral studies at the Clinical Co-Operative Group-Leukemia in Munich. Dr. Ahmed's current research interests are studying the molecular regulation of normal and malignant hematopoiesis and HSC self-renewal with the hope to identify underlying processes that lead to leukemic transformation and progression. Projects in Dr. Ahmed's group focus on identification and characterization of candidate leukemic stem cell (LSC) in hematopoietic malignancies and therapeutic targeting of the leukemic cells that drive human leukemia. Dr. Ahmed is currently a

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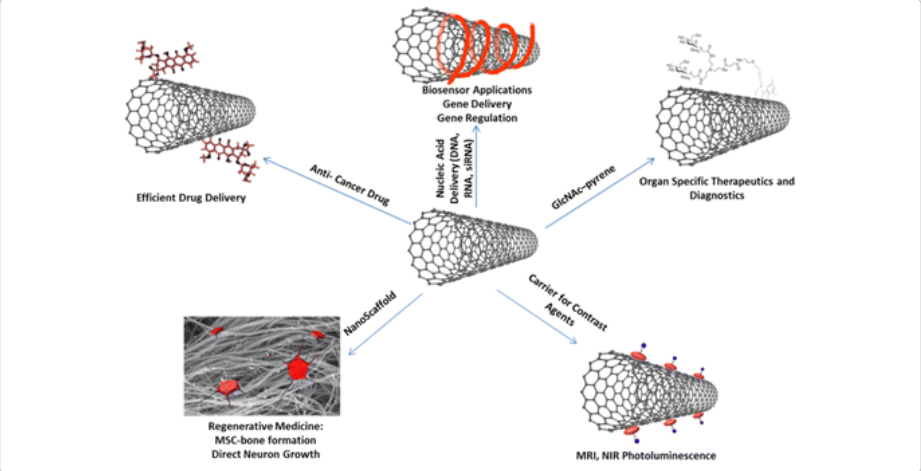
member of several scientific societies such as International Society for Stem Cell Research (ISSCR), European Hematology Association (EHA), and ISEH—Society for Hematology and Stem Cells.

Biography

Adnan Memic graduated summa cum laude with a B.Sc. in Chemistry. He received his Ph.D. in Chemistry/Biochemistry from Wayne State University, Detroit, MI, U.S., with Mark Spaller. He was a postdoctoral fellow in Chicago with Brian Kay at the University of Illinois. He was previously a Visiting Assistant Professor of Toxicology and Pharmacology at Dartmouth's Geisel Medical School. He joined King Abdulaziz University in 2010, was promoted to Associate Professor of Nanotechnology, and is concurrently a part-time Lecturer on Medicine at Harvard Medical School. His research focuses on bioactive molecule discovery and development including generation of biomaterials, carbon nanomaterials, chemical and peptide analog libraries, protein and antibody engineering toward solving challenges in targeted drug delivery, biosensing, and tissue engineering and regenerative medicine applications.

Abstract



Carbon nanotubes (CNTs) represent one of the most studied allotropes of carbon. The unique physicochemical properties of CNTs make them among prime candidates for numerous applications in biomedical fields including drug delivery, gene therapy, biosensors, and tissue engineering applications. However, toxicity of CNTs has been a major concern for their use in biomedical applications. In this review, we present an overview of carbon nanotubes in biomedical applications; we particularly focus on various factors and mechanisms affecting their toxicity. We have discussed various parameters including the size, length, agglomeration, and impurities of CNTs that may cause oxidative stress, which is often the main mechanism of CNTs' toxicity. Other toxic pathways are also examined, and possible ways to overcome these challenges have been discussed.

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Received 12 November 2015
Published online 4 May 2016
Published in print 22 September 2016

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