Nanoparticle Delivery of Repair Enzymes for Radiation Protection/DNA Repair

James F. Leary, University of Texas Medical Branch

Biomolecular Systems Research Program

This program will develop a nanotechnology-based Biosensor diagnostic and therapeutic system to detect potentially radiation-damaged cells and to provide radiation protection and/or DNA repair enzymes to white blood cells in the peripheral blood of astronauts exposed to radiation in space. A multi-disciplinary team of scientists with expertise in targeting and detection of rare blood cells, DNA repair, nanoparticle technology, and in-vivo imaging will develop a minimally invasive, smart-biosensor nanotechnology that can be potentially read non-invasively by detecting the nanoparticle fluorescence as cells flow naturally through blood vessels in the eyes of astronauts. The focus of this grant is to provide as much in-vivo protection as possible against radiation damage to the blood and bone marrow of astronauts, to provide in-vivo intra-cellular DNA repair to damaged cells that can be repaired before thesecells go on to become radiation- induced leukemias, or if necessary search out and destroy (by inducing apoptosis) radiation-caused cancer cells in blood.

Description

Task 1: Construct DNA repair enzymes and test on human cells in-vitro and ex-vivo

Task 2: Development of Biomolecule-Nanoparticle biosensors for drug delivery to radiation-damaged cells [Lvov and Kotov]

Task 3: Characterization of nanoparticle taweting and target cell responses

Task 4: In-vivo Cellular Distributions & Characterization of Smart Nanoparticles for Recognition and Targeting and Selective Killing Of Transformed Cells:

Innovative Claims/NASA Significance

A novel strategy of in-vivo signal generation in response to the sensing of particular types of radiation-induced damage is proposed using a non-invasive, in-vivo flow cytometric sensing of fluorescently-labeled radiation-exposed blood cells as they flow through a blood vessel in the eye as measured on astronauts using special eye goggles with wireless transfer of data to a portable computer. The proposed data acquisition system would be non-invasive, allowing periodic or continuous monitoring of radiation damage levels. A novel method of delivery of repair molecules allows targeted and specific, rather than untargeted and non-specific delivery, of repair molecules to the affected cells while preventing their exposure to healthy cells. Lastly, a novel concept forfuture consideration involves the genetic engineering of hematopoietic stem/progenitor cells for increased resistance to radiation damage.