The Torch
Vol. 3 (40)

Artificial human erythrocytes from nanotechnology

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Despite being a new field of study, nanotechnology has shown promise in medicinal and therapeutic applications. One key implication of this understanding is that building devices on the micron and nanometre-scale to achieve exact control of matter at the atomic or molecular level may be feasible. Among the possibilities are gerontological (study of mental and social implications on ageing) components that reverse atherosclerosis, rewrite DNA in vivo and repair brain damage. One such example is "Respirocyte" which could produce a meaningful result as an artificial mechanical erythrocyte. These so-called respirocytes are hypothetical blood-borne nanomachines that are supposed to outperform human erythrocytes. Robert A. Freitas Jr. came up with the idea of a "mechanical artificial red blood cell" in 1998. However, the intoxication generated by the surrounding haemoglobin-containing substitutes was the main hurdle in making this a reality. To counteract this, perfluorocarbon emulsions were employed to coat the respirocytes. This method also had several drawbacks, including reduced oxygen-carrying capacity, lipophilicity-induced instability and side effects, such as phylactic response. As a result, a new technique was presented, in which synthetic red blood cells (RBCs) were created by coating donor RBCs with a silica coating. They then placed positively and negatively charged polymers on top of the silica-RBCs before etching the silica away. Even though this strategy was successful in resolving the toxicity issue, it did not address other difficulties, such as oxygen-carrying capacity, buoyancy or pressure tolerance. Later, a 1 atm spherical pressure vessel powered by endogenous serum glucose was proposed. The proposal calls for 12 pumping stations to be evenly spaced across an equatorial circle. In addition to sorting rotors, each station would have its engine for metabolising glucose. Pumping ambient O2, CO2 and H2O into an inner chamber generates enough energy to power the respirocyte. The number of rotors depends on the expected concentration of each target chemical in the bloodstream as well as performance requirements. Nearly half of the respirocyte's surface is covered by equatorial pumps. The remaining surface has a global "bar code”. This coding allows a clinician with a little blood sample and an electron microscope to easily identify a product. It may also allow reading by future medical nanorobots. They may allow doctors to carefully manage oxygen and carbon dioxide saturation curve profiles independently, either to maximise gas transport efficiency or to meet specialised demand functions dictated by emergencies, uncommon activities or specific medicinal treatments. Power, atomic-scale manipulation, immunological reactivity or toxicity, computing and communication are some of the common challenges that prevent the development of a respirocyte. Creating such a device would necessitate several technological advances.

Keywords: Artificial erythrocyte, Respirocyte, Atherosclerosis, Nanotechnology, Nanomedicine

Citation:
Tamal Bhaumik. Artificial human erythrocytes from nanotechnology. The Torch. 2022. 3(40). Available from: https://www.styvalley.com/pub/magazines/torch/read/artificial-human-erythrocytes-from-nanotechnology.