

DNA Taxi: Photosensitive gold nanoparticles bind and release DNA

April 27 2006

Despite few successes to date, gene therapy is a highly promising approach for medical therapy in the future. One of the biggest difficulties with this process is finding a suitable transport agent that can carry the nucleic acid being used as a “drug” into the diseased target cell. Killed viruses have been used as "taxis" for these genes, but these often have unexpected health consequences.

Recently, nanoparticles have been developed for gene therapy. A successful example of this has been described by V. M. Rotello, N. S. Forbes, and their co-workers in Massachusetts, USA.

They used tiny spheres of gold with tightly packed, positively charged hydrocarbon chains bound to their surface. These chains contain a photolabile bond that is stable to visible light but breaks when irradiated with UV light at a wavelength of 350 nm. This causes the positively charged fragment to fall off, leaving the gold sphere with a negative charge on its surface.

DNA contains negatively charged phosphate groups that allow it to bind to the positively charged gold spheres through electrostatic interactions. Cells that were brought into contact with gold spheres loaded with DNA allowed these “DNA taxis” to pass into their interior. The signal to “unload” was given by subsequent irradiation with UV light: it destroyed the photolabile bond, reversing the surface charge of the gold particles and releasing the DNA. Fortunately, the DNA was not only brought into the cytoplasm; it made its way to where it was needed: the cell nucleus.

This is the location in the cell where DNA molecules are copied for translation into proteins or are multiplied for cell division.

This process offers a relatively simple possibility for the transport and controlled release of DNA into living cells. In addition, the authors believe that this method should make it possible to steer interactions with other biomolecules, such as proteins or pharmaceutical agents, making it possible to target specific cells.

Citation: Vincent M. Rotello et. al., *Angewandte Chemie International Edition* 2006, 45, No. 19, 3165–3169, doi: 10.1002/anie.200600214

Source: Angewandte Chemie

Citation: DNA Taxi: Photosensitive gold nanoparticles bind and release DNA (2006, April 27) retrieved 23 April 2024 from <https://phys.org/news/2006-04-dna-taxi-photosensitive-gold-nanoparticles.html>

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