Non-Confidential Description - PSU No. 4590
"Improved Method of Drug Delivery using a Retro Diels-Alder Reaction"

Field of Invention/ Keywords:
Drug release, gene delivery, siRNA, temporal control, locational control, Diels-Alder reaction, gene silencing

Links:
Lab website

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Background
Stimuli-responsive drug delivery techniques are an increasing area of interest particularly for the delivery of gene-silencing nucleic acid sequences into cellular systems. Stimuli used in current techniques include pH-sensitive release, photo-liable linkages, and thermally-based methods. Upon stimulation, a therapeutic agent enters an active form; it can be applied at a specified time and location in the body and in a specific amount. There is a need for alternative compositions and methods for improved targeted delivery that have enhanced temporal control such as long-circulating delivery vehicles and step-by-step, multiplex activation.

Invention Description
This invention discloses a method of drug delivery using a magnetic nanoparticle, a therapeutic species, and a linker joining the two comprised of a Diels-Alder cyclo-addition reaction product. The nanoparticle converts magnetic energy to thermal energy, which heats the nanoparticle. The heated particle then reaches the activation energy for initiating a retro Diels-Alder reaction. This reaction decomposes the Diels-Alder product of the linker, thereby severing the linker and decoupling the therapeutic species (drug, nucleotide, etc.) from the nanoparticle. Changing the elemental structure of the diene molecule in the Diels-Alder product allows for a customized reaction energy to sever the link.

Advantages/Applications
- Linkers can be designed with different reaction energies; multiple trigger points for the release of each linker design provide the ability to deliver various sequences in multiplexed manner
- Can be used to deploy drugs, genes, or nucleic acids; siRNA could be deployed for gene silencing
- Heats nanoparticles without damaging surrounding tissues; reaction energies are sub-toxic
- Can circulate long-term in the body before later activation

Patent Status
Provisional pending. Filed 7/14/2017

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