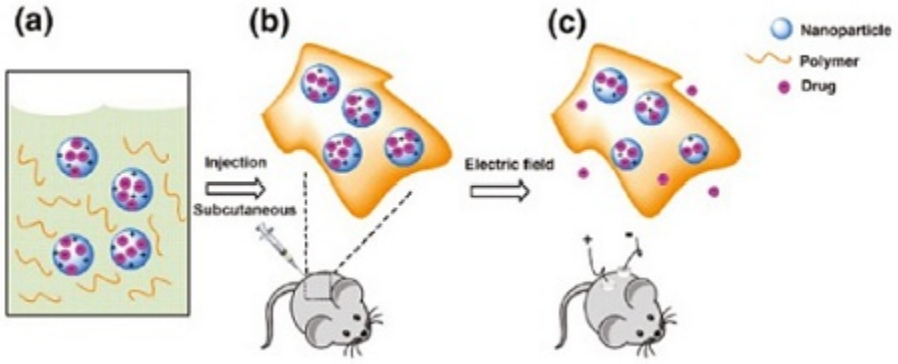
Docket #: S10-297

Drug Release Controlled by External Electric Field

Richard Zare's lab at Stanford University has developed a ground-breaking drug release system in which injected medication can be controlled externally with excellent spatial, temporal, and dosage control. Specifically, nanoparticles of a conducting polymer (polypyrrole) are loaded with the drug of interest and injected locally with the assistance of a temperature-sensitive hydrogel. The drug release from the conductive nanoparticles is controlled externally by the application of a weak, external DC electric field. Unlike other drug release systems which involve implantable chips or delivery of drugs with laser pulses, ultrasounds or magnetic fields, no surgery or complicated instrumentation is required.



Application of system: (a) Nanoparticle-polymer solution is (b) subcutaneously injected into a mouse, followed by (c) application of a DC electric field to induce release of the drug cargo inside the nanoparticles.

Applications

- **Drug delivery** - wide range of applications such as pain control, cancer treatment, diabetes control.

Advantages

- **Simple release mechanism** - straightforward instrumentation is needed, no surgery
- **Convenient dosing** - singel dose injected once and controlled externally
- **Minimally invasive** - weak electric field is applied from outside the body
- **Minimizes side effects** by targeting drugs to localized areas.

Publications

- U.S. Published Patent Application 20120238943, "METHODS OF ELECTRIC FIELD INDUCED DELIVERY OF COMPOUNDS, COMPOSITIONS USED IN DELIVERY, AND SYSTEMS OF DELIVERY ".
- Niloufar Hosseini-Nassab, Devleena Samanta, Yassan Abdolazimi, Justin P. Annesb and Richard N. Zare, "Electrically controlled release of insulin using polypyrrole nanoparticles," *Nanoscale* 2017.
- Devleena Samanta, Niloufar Hosseini-Nassaba and Richard N. Zare, " Electroresponsive nanoparticles for drug delivery on demand," *Nanoscale*, 2016,8, 9310-9317, DOI: 10.1039/C6NR01884J.
- Methods of electric field induced delivery of compounds, compositions used in delivery, and systems of delivery (U.S. Patent Application Publication No. 20120238943)
- Jun Ge, Evgenios Neofytou, Thomas J. Cahill, III,Ramin E. Beygui, and Richard N. Zare, Drug Release from Electric-Field-Responsive Nanoparticles , *ACS Nano*, vol. 6, no.1, pp. 227-233, 2012, published online November 23, 2011, DOI: 10.1021/nn203430
- Spark of Genius: Releasing Drugs from Electric-Field-Sensitive Nanoparticles, *ACS Nano* Highlights, Vol. 6, No. 1, p. 5, 2012, published online January 24, 2012, DOI: 10.1021/nn2050328

- External electric fields trigger drug release from new hydrogel formulation, *Nanomedicine* March 2012, 7(3), p. 316, Research Highlight, DOI: 10.2217/NNM.12.19
- Smart Drugs Get Zapped , *Chemical & Engineering News*, Dec 6, 2011.

Patents

- Published Application: 20120238943
- Published Application: WO2012125552
- Issued: 9,713,702 (USA)

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