# XLINK InsuLite: Revolutionary Insulin Delivery System

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## Motivation

**Current insulin treatments:**

- Traditional syringe: Painful and intimidating
- Insulin Pump: Complicated use and high risk of infection
- Exubera: Not approved for children, needle injections required

## XLINK Insulite

Our mission is to develop and market a portable light source that, when used with an insulin-loaded biopolymer, delivers insulin to the body in a pain-free fashion.

## InsuLite Design: Two Components

**External Light Source: 870 nm LED with built-in safety controls**

- Lighter than 100 grams
- Smaller than 3.75 $cm^3$
- Fit onto watch (Fig. 1)
- 2 year LED life and battery life
- Less than $1000

Figure 1. CAD drawing of light source attached to wristwatch and biopolymer-nanoshell composite.

**Implant: Drug loaded Nanoshell-Biopolymer Composite**

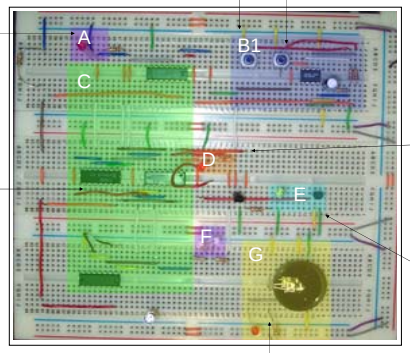
- *N*-isopropylacrylamide-co-acrylamide (NIPAAm-co-AAm) hydrogels embedded with silica core, gold coated nanoshells
- Temperature responsive material that expands when temperature exceeds set point, enabling controlled drug release

## External Light Source

**Activate (B1):** Turns on light source, initiating treatment

**Treatment Complete (A):** Alerts user that treatment has completed

**Emergency Off (B2):** Shuts off light source/ disrupts treatment phase



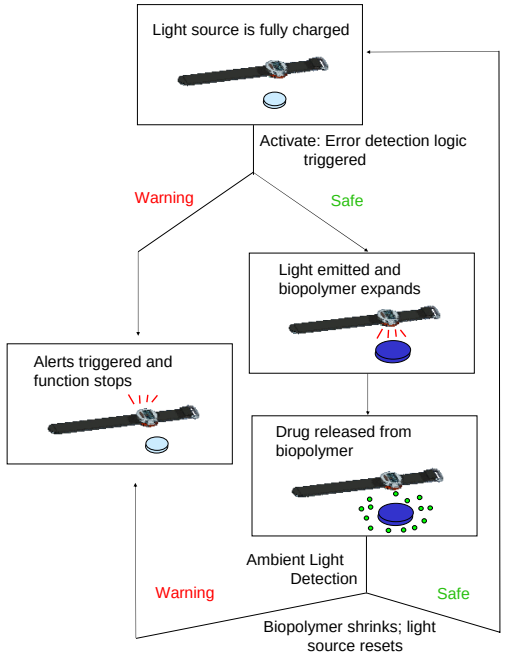

**Treatment in Progress (D):** Indicates Treatment is underway

**Error Detection Logic (C):** Inherent safety mechanism that detects when any component of circuit has malfunctioned. Visually alerts user (F).

**Battery Voltage Detector (E):** Monitors battery life and visually alerts user when battery power is low

Figure 2. Finished light source product.

**Ambient Light Detector (G):** Detects wavelengths above 700 nm and audibly and visually alerts user about presence of ambient infrared light




## Testing

**Aim 1: Test 870 nm light effects on biopolymer-nanoshell composite**

- Measure temperatures of solution containing nanoshells and pure water while both are exposed to 870 nm light

**Aim 2: Determine effectiveness of InsuLite light source**

- Measure light intensity output from InsuLite
- Measure light intensity required to activate drug-release from biopolymers

**Aim 3: Observe drug release after biopolymer activation**

- Load biopolymers with bovine serum albumin (BSA)
- Activate biopolymers while suspended in water
- Monitor concentration of BSA in water solution over time

## Results

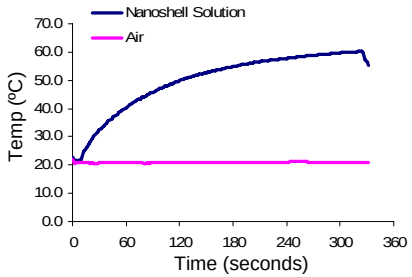



Figure 3. Temperature measurement in air and within nanoshell solution.

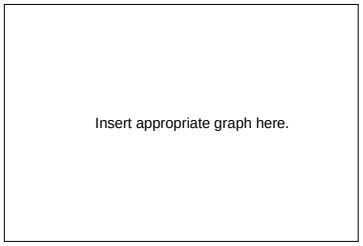



Figure 4. Temperature measurements of biopolymer under different light intensities.

-Temperature of nanoshell solution rises in presence of 820 nm light (Fig.3)

- External light source successfully activates biopolymer
- Drug released occurred while light source was on (Fig. 4)

## Discussion

- The InsuLite offers a **pain-free** alternative to current insulin treatments, requires little upkeep, and limits user interaction.
- NIR light-nanoshell reaction does not affect tissue surrounding implant.
- Most ambient light will not activate biopolymer.
- If biopolymer is improperly activated, the light source will detect the error and alert the patient.
- Future upgrades to the InsuLite include embedding glucose sensors into the light source for full automated, real-time glucose delivery as well as record keeping of dosage.

### References

Sershen, S et al. Adv. Drug Delivery Rev., 2002; 54, 1225-1235.
Sershen, S et al. Nature Materials, 2002; In Press.

### Acknowledgements

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