

## Technical Brief

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# Mitochondria Targeting Non-Isocyanate Polyurethane Nanocapsules for drug delivery and imaging

### Technology Summary

Non-isocyanate polyurethane nanocapsules (NIPU) that can be used as a site-specific delivery vehicle to improve the therapeutic efficacy of a drug or be used to produce organelle-specific imaging studies.

### Background

Mitochondria dysfunction is associated with various human diseases. However, specific localization or distribution of drugs within the mitochondria of live cells remains a big challenge. In recent years, different kinds of mitochondria-targeted nanosystems have been developed, with polyurethane nanocapsules receiving a lot of attention for its biocompatibility and low in vivo toxicity among other characteristics. Unfortunately, the use of a potential carcinogen such as isocyanate in the synthesis of polyurethane is not desirable, and thus, the development of site-directed non-isocyanate polyurethane nanocapsules is of great interest.

### Technology Description

The inverse mini-emulsion technique was used to produce rhodamine/doxorubicin - encapsulated nanocapsules containing urethane linkages. The resulting nanocapsules were modified with alkylated triphenylphosphonium cation to facilitate the permeation of the nanocapsules through the mitochondrial membrane and to improve the mitochondrial targeting efficiency. The stability of the nanocapsule dispersion was confirmed using DLS, SEM, and TEM. Cellular uptake of these capsules was ascertained using structured illumination microscopy. Finally, the stimuli responsive rupture of the nanocapsule with subsequent release of the cargo was studied in zebrafish embryo using esterase.

### Value Proposition

- High stability and mono-dispersion
- Improved therapeutic efficacy of bioactive
- Non toxic method of preparation of Nanocapsules by using cyclic carbonate over isocyanate monomer
- Biodegradable nature of polyurethane nanocapsules
- Controlled release rate

### Market Potential

The global drug delivery systems market size was valued at USD 34.70 billion in 2021. The market is projected to grow from USD 39.33 billion in 2022 to USD 71.75 billion by 2029, exhibiting a CAGR of 9.0% during the forecast period.

### Applications

These nanocapsules find application in site-specific delivery of bioactives, medical, food And nutritional supplements, cosmetics, and agricultural production. These nanocarriers also offer a promising platform for biological imaging.

### Technology Status

- Demonstrated at lab scale
- Patent protected
- Seeking interested industry partners