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Electrospinning of Polycaprolactone Core-Shell Nanofibers with Anti-Cancer Drug

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OBJECTIVES

- Develop a novel cancer drug delivery system using a biocompatible core shell nanostructures for targeted delivery and minimize side effects caused by conventional chemotherapy method
- Processing and manufacturing of drug loaded nanofibers and determination of structure property relationship.
- In-vitro drug release and cell viability tests of the drug loaded nanofiber in a standard biological media

EXPERIMENTAL WORK

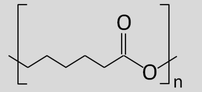
- Coaxial electrospinning of biocompatible, biodegradable polymer encapsulating anticancer drug
- Testing of nanofibers in UV-Vis Spectrometer at a controlled temperature over a prolonged time period in a biological media
- Different biocompatible polymer with different degradation rate has been used to develop drug loaded nanofibers to get variable drug release profile
- Nanofibers release drug by biodegradation of shell polymer of coaxial structure and diffusion from the pores of shell
- Confocal laser microscopy to represent drug release from the fiber mats
- Cytotoxicity tests were performed with human prostate cancer cells in the department of Biology.

FUTURE WORK

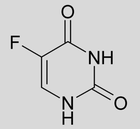
- Functionalize drug loaded nanofibers with cancer cell targeting agents such as antibody
- Conjugate nanofibers with pH sensitive polymer to obtain capability of delivering drug only at cancer cell environment
- Develop nanospheres encapsulating drug to obtain better permeability into human tissues and blood vessel
- In-vitro testing of cancer drug delivery device to get the cytotoxicity and killing curve
- Testing of drug loaded nanofibers in a zebra fish containing human prostatic cancer cell to show its efficacy

MATERIALS AND METHOD

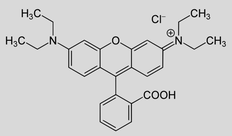
- Polycaprolactone (PCL) solution was prepared by dissolving 14% PCL (avg. mw 80,000) into dimethylformamide (DMF) at 110°C
- 5% 5-Fluorouracil (FU) was dissolved into DMF at 60°C
- 1% Rhodamine B and 5% 5-Fluorouracil was dissolved into DMF at 60°C
- Nanofibers of PCL encapsulating FU was electrospun at 1 ml/hr and 0.2ml/hr flow rate respectively under 21KV
- Nanofibers of PCL encapsulating fluorescent marker Rhodamine B and 5-Fluorouracil was electrospun at 0.9ml/hr and 0.2ml/hr flow rate respectively under 21.2KV
- Nanofiber were collected on a wax-paper on a flat plate collector. Nanofibers were washed using deionized water and dried in vacuum chamber for 8hours
- 20x20mm drug loaded nanofibers were put into PBS and their absorbance were recorded at 265nm using UV-Vis spectrometer to get drug release profile
- Human prostatic cancer cells were used to determine cytotoxicity of nanofibers



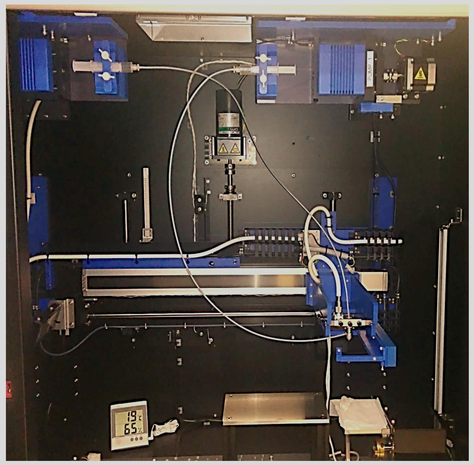
Polycaprolactone



5-Fluorouracil

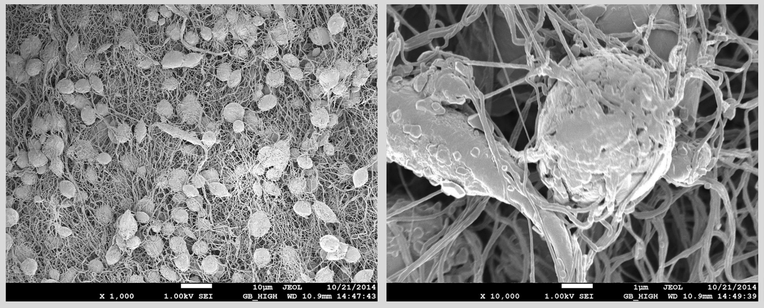


Rhodamine B

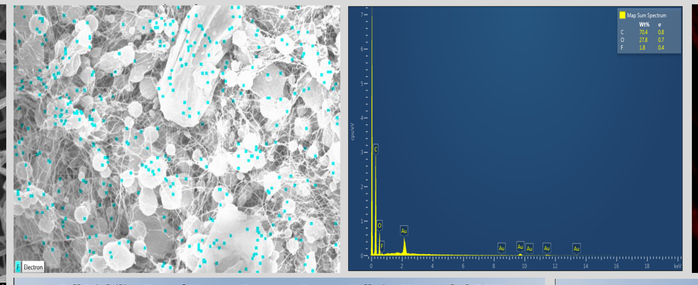

Electrospinning with coaxial spinneret

RESULTS

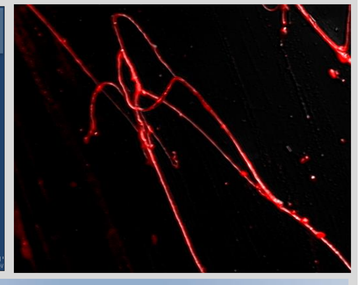
SEM Images of FU loaded PCL Nanofibers



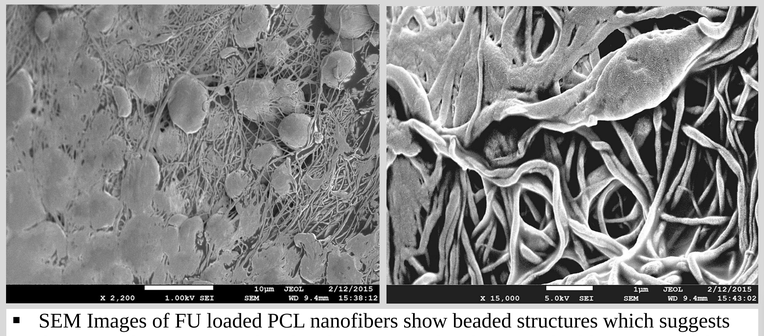
EDS Plot Showing Presence of FU in Nanofibers



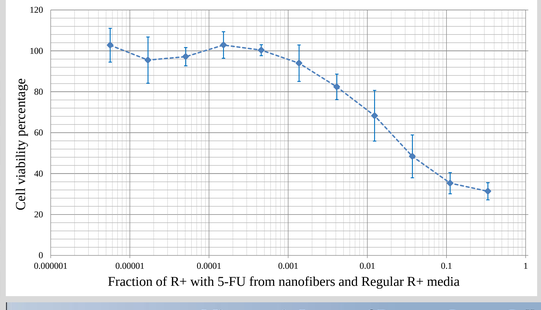
Confocal Laser Microscopy of Fibers



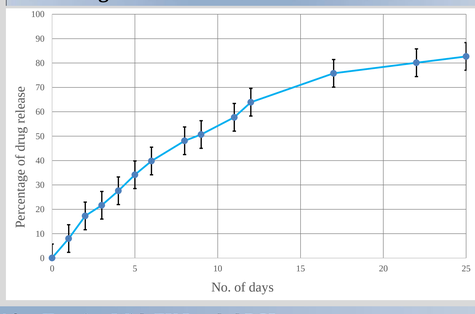
SEM Images of PCL Nanofibers After Releasing FU



Cell Viability Test of Human Prostate Cancer Cells in FU Loaded PCL



Drug Release Profile of FU Loaded PCL



- SEM Images of FU loaded PCL nanofibers show beaded structures which suggests drug crystals was encapsulated within it. EDS plot shows negligible amount of drug is attached to the surface
- Drug release profile in a biological media of FU loaded PCL nanofibers exhibit a controlled release over a prolonged time period
- Cell viability test of human prostatic cell confirms the efficacy of FU Loaded PCL nanofibers
- Florescence of Nanofibers in confocal microscopy demonstrate that both FU and Rhodamine B is encapsulated within PCL nanofibers

Microscopic Images of Prostate Cancer Cell After Treating With FU Loaded PCL