# Micro Drug Delivery System for Heart Disease

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## 1. INTRODUCTION & MOTIVATION

- For the last decades, Coronary Artery Disease (CAD) has been the deadliest disease in the world.
- CAD caused 8.76 million deaths in the year 2017 according to the World Health Organization (WHO).
- In Saudi Arabia:
  - CAD is the leading cause of death in the year 2016.
  - The number of death had a 20% increase from the year 2005 to 2016 according to WHO.

Existing interventions and drawbacks:
- Angioplasty: Re-narrowing of the artery within the stent
- Blood clot formation
- Compressed plaque
- Re-narrowing in the surrounding of the stent
- Coronary Artery Bypass Grafting (CABG):
  - Long surgery (6 - 8 hours) under general anesthetic
  - Risk of bleeding from the grafting area
  - Heart rhythm problems and blood clots which higher the risk of stroke
- Angioplasty

To definitively eradicate the disease, a new treatment technique is required.

## 2. DESIGN & CONCEPT

- A micro drug delivery system consisting of an electrolytic pump and drug reservoir with micro-needles is attached to a balloon catheter that pushes the micro-needles into the artery walls.
- Actuation of the pump allows drug delivery through micro-needles to the fatty cholesterol layer.

## 3. FABRICATION

### Interdigitated electrodes fabrication process

1. Spin photoresist
2. Pattern photoresist
3. Deposit metal
4. Strip photoresist

### Bellows membrane fabrication process

1. Spin photoresist
2. Pattern photoresist
3. Etch Silicon
4. Refill holes

### PDMS casting

5. PDMS casting
6. Cutting sacrificial mold
7. Parylene coating
8. Membrane release

### 3D Printing

9. 3D Printed model
10. Parylene coating
11. Membrane release

### Penetration test of a 200 µm long microneedle into PDMS film (Scale bar 50 µm)

### Red-dye delivery through micro-needles using water electrolysis pump

## 4. CHARACTERIZATION & TEST

Penetration test of a 200 µm long microneedle into PDMS film

Micro-bells membrane expansion using electrolysis

## 5. CONCLUSION & FUTURE WORK

- A new treatment method for coronary artery disease has been proposed
- Fabrication of a micro-pump for drug delivery has been achieved
- The assembly of the drug reservoir and micro-pump has been tested successfully
- In process: Assembly of the drug delivery system on top of the balloon catheter