

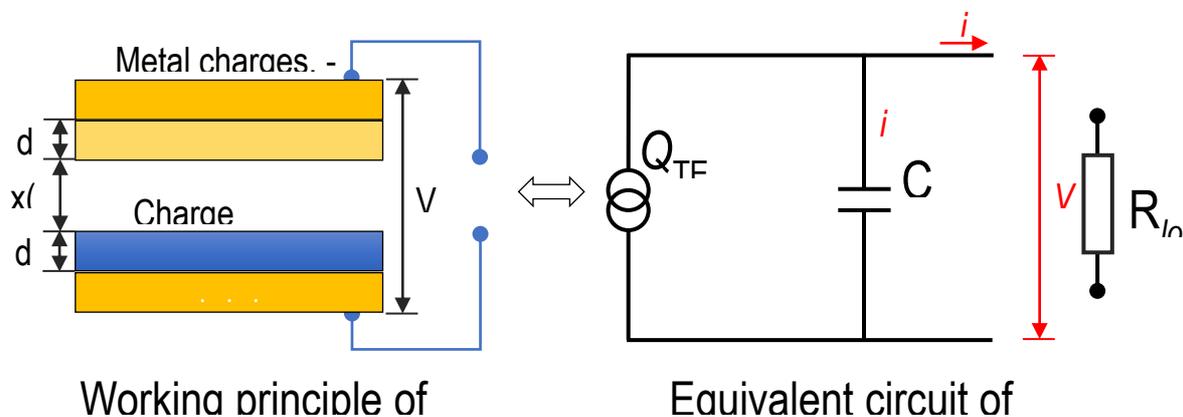
## Low-impedance triboelectric generator using liquid

Semester project, Master project, Internship

(Section: microengineering, microelectronics)

In the world where the population keeps increasing and aging, the demand for all-in-one microsystems or functional devices that are integratable, self-powered and friendly to users and to the environment is rapidly rising. Based on the current state of research in the field, we aim to develop a micro energy harvester for wearable applications. Owing to the high voltage output and energy conversion efficiency, triboelectric generator (TEG) is one of promising energy harvester candidates to power supply the microsystems. However, there are two technique challenges in the research and development of TEGs: ultrahigh internal impedance and low contact area.

In this project, the goal is to design novel TEG device structure with low impedance and use liquid as one of triboelectric material.



Working principle of

Equivalent circuit of

### Work description:

- 3D printing and surface modification
- Mechanical vibration system setup
- Electrical measurement

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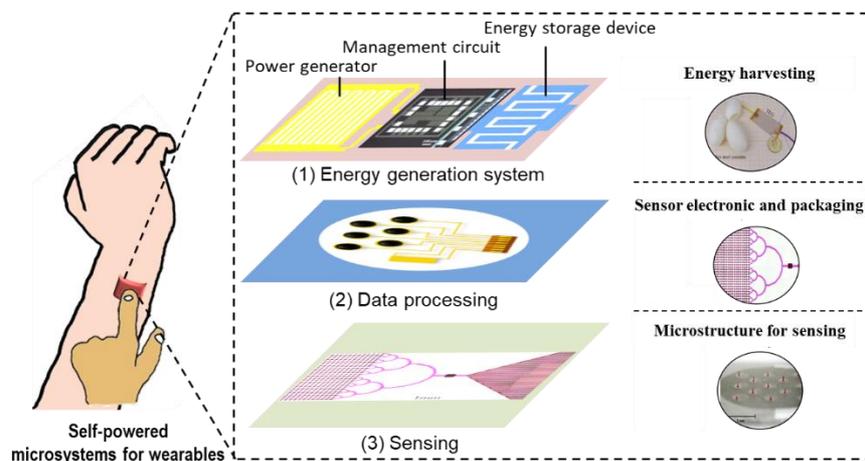
## Micro power generator and storage for wearables

### Master project / Semester project

(Section: microengineering, microelectronics, circuit design)

In the world where the population keeps increasing and aging, the demand for rapid, precise bio-medical devices that are friendly to the user and to the environment is rapidly rising. Based on the current state of research in the field, we aim to develop a self-powered microsystem for wearable applications, including energy generation system, data processing and sensing. For wearable, portable sensors, electrical power is needed. Among several ways to harvest energy by wearable devices, triboelectric generator (TEG) is a relatively novel approach and implementation that has already delivered some remarkable results. An open challenge is yet how to store and use the created power peaks for a sensor device. A schematic illustration of the system components and how they will be stacked in the final assembly is shown in the following figure.

In this project, the goal is to create energy harvester component comprising the TEG, power management circuit and energy storage device



#### Work description:

- Circuit simulation, Multiphysics simulation (COMSOL)
- Mechanical vibration system setup
- Electrical measurement

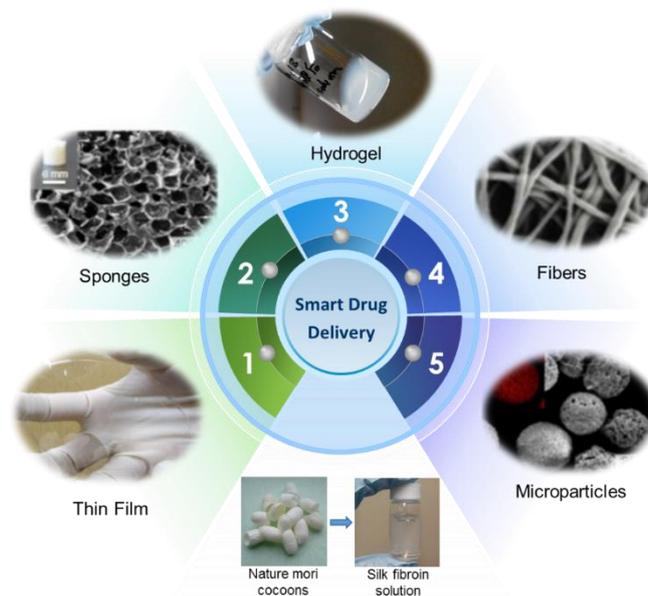
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## Natural polymer for drug delivery applications based on microengineering

### Master project / Semester project

(Section: microengineering, material sciences)

Silk fibroin is a kind of natural protein polymer, which has been widely used for drug delivery applications. It shows a unique combination of beneficial properties for drug delivery, including controllable biodegradation, biocompatibility, aqueous-based purification and processing options, compatibility with sterilization methods, and robust mechanical properties. Furthermore, silk fibroin can be easily processed to various formats including films, sponges, hydrogels, microparticles, microneedles and so on, which offers a versatile toolkit for various drug delivery applications. The goal of this project is to develop external trigger mainly magnetic field responded and fully biodegradable drug delivery implant based on silk fibroin.



#### Work description:

- Fabrication of silk composite membrane
- Characterization of the thermal responsive behavior of materials
- Characterization of the mechanical and biodegradable properties of materials: Young's modulus, degradation time
- Drug release application

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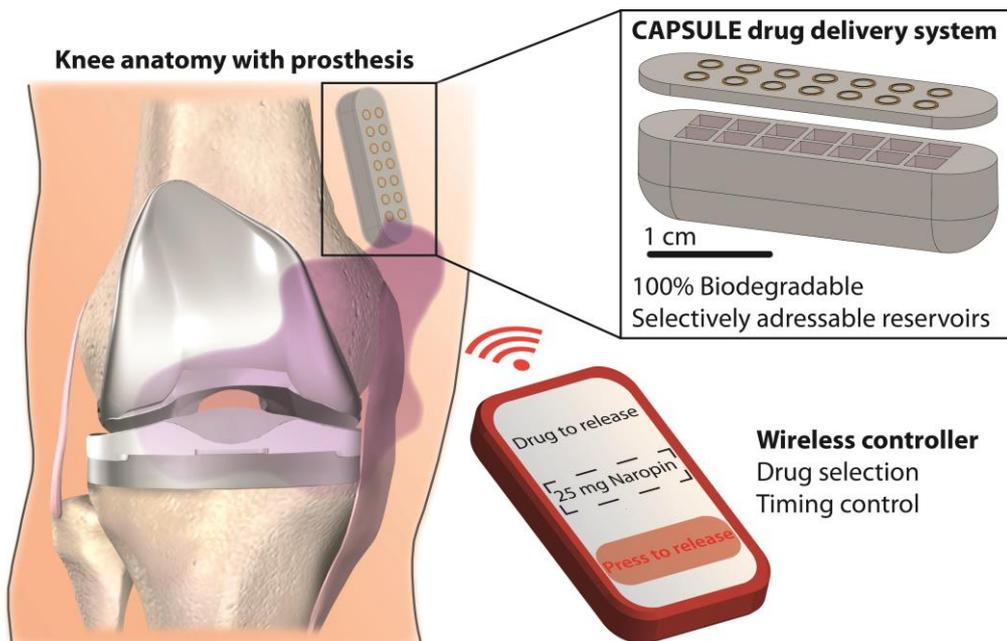
## Bonding-in-liquid technique for biodegradable drug delivery capsules

### Semester Project / Internship

(Sections: microengineering, material science)

Drug delivery systems (DDS) are engineered in order to improve therapeutic performance of oral pills and repeated injections. Fabricating DDS out of biodegradable materials enables these devices to be naturally eliminated by the body once their function completed. There exist several biodegradable polymers which naturally degrade by hydrolysis in a biological environment and which degradation rates can be easily tuned from a few weeks to several months.

The goal of this project is to develop a bonding-in-liquid technique for liquid encapsulation into biodegradable polymeric drug delivery capsules. Throughout this project, you will gain experience with polymer processing and knowledge about biodegradable materials and drug delivery systems. Hence, we are looking for a highly motivated student with a strong interest in biomedical engineering and material science.



#### Work description:

- Fabrication of biodegradable polymeric capsules
- Development of a bonding-in-liquid technique for liquid encapsulation

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