ELECTROPHYSIOLOGY ON A MICROCHIP

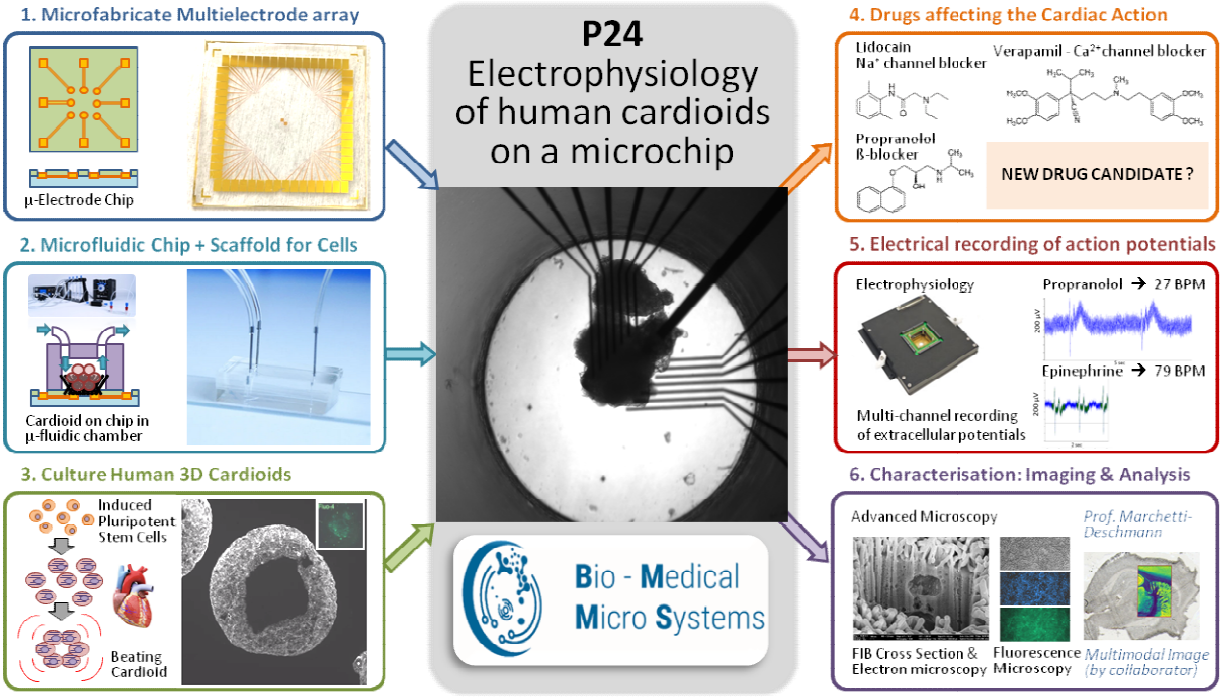

Fig.1 Concept of Project 24 "Electrophysiology of human mini-hearts on a microchip"

Supervisory Team[1]

Primary Supervisor: *Dr. Heinz Wanzenboeck – Institute for Solid State Electronics*

TU Wien project partners: *Dr. Stefan Baudis – Institute of Applied Synthetic Chemistry*
Dr. Aleksandr Ovsianikov – Inst. f. Materials Science & Technol.
Dr.Martina Marchetti-Deschmann – Inst. f. Chem. Technol. & Analytics

External academic partners: *Dr. Sasha Mendjan - Institute of Molecular Biotechnology*

External industry partners: *Dr. Steffen Hering - Chan:Pharm Drug Discovery GmbH*
Dr. Michael Mühlberger – Profactor GmbH

Project Description

This PhD project focuses on the development of a **beating human mini-heart on a microelectronic chip**. Such artificial, miniaturized 3D replicas of human organs, so-called organoids, are popular models for pharmaceutical and medical studies. Organoids grown from human cardiomyocytes, so-called cardioids, are especially relevant to test arrhythmia-causing effects of substances – a test that is obligatory for all potential new drug candidates before admission to the market.

[1] The Early Stage Researchers (ESRs) will be accompanied during their thesis by an individual "Thesis Advisory Committee" (TAC), which will guide the ESR through the graduate studies. The TAC will consist of the thesis primary supervisor, and two additional members of the Supervisory Team selected by the ESR.

By utilizing different microfabrication methods the **microfluidic device** with the **microelectrode array** will allow to record extracellular – and potentially also intracellular – **recordings of the action potentials** from the beating human "mini-heart". A **cardio myocyte-fibroblast co-culture** – ideally with a **scaffold defining the 3D-structure** – will be used. **Test substances** and drug candidates will be added to this long-term cardioid model.

This cardioids-on-a-chip system will provide a platform for realistic drug-testing – especially for arrhythmia-related effects. Moreover, this **artificial heart on an electrophysiologic chip** will be **established as versatile tool** to assist medicine and pharmacology.

Key Goals and Tasks

The **primary goal** (technological goal) of this PhD thesis is to use the unique capabilities of microfabrication to (i) **replicate the in-vivo environment** of the human organism on a microchip and (ii) utilize **electrical recordings** with the microelectrodes on the chip **to monitor the beating activity** of a human "miniature heart" (aka cardioid).

By using the human cardioids on the microchip the **secondary goal** (biological goal) is to study and **quantify the impact of** a range of **external stimuli – new drug candidates, environmental factors** as well as electromagnetic fields - not only on the immediate cellular activity, but also **study long term effects** and monitor the electrophysiology of cardioids.

Tasks of this PhD project include:

- Fabrication of a microchip with microelectrodes in the clean room of TU Wien.
- Setup and operation of a pump-controlled microfluidic system
- Stem cell differentiation and growth of cardioids in our cell culture laboratory
- Multi-channel recording of action potentials during contraction of the cardioids
- Electrophysiological measurements under influence of added drugs
- Electron microscopy, fluorescence microscopy, biomolecular analysis of samples.

For activities where you have no previous experience, you will be trained by experts and guided through your activities until you can perform the activities independently.

Additional to those research activities your duties will be:

- Preparation of scientific publications as first author
- Co-supervision of younger colleagues
- Travel to project meetings, scientific conferences and research visits at collaborators

Project-specific Requirements

- At the time of application: **completed master study** in one of the following areas:
  - ➢ Electrical engineering
  - ➢ Biomedical technology
  - ➢ Material sciences
  - ➢ Physics
  - ➢ Chemistry
  - ➢ Pharmacy
  - ➢ Biology (e.g. mol. biology)
  - ➢ or a related field
- Skill and passion for **experimental work**
- Solution-oriented **hands-on mentality**
- Readiness to work in a clean room environment and in a cell culturing environment
- Team worker in an interdisciplinary environment.
- Very good English language skills in the scientific field