

# Magnetically Enhanced Microflow Cytometer for Bead- and Cell-based Immunoaffinity Measurements in Whole Blood Samples



Scientific thesis for the attainment of the academic degree  
Master of Science (M.Sc.)  
of the Department of Electrical and Computer Engineering  
at the Technical University of Munich.

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# 1. Introduction and Motivation

## 2. Theoretical Prerequisites

### 2.1. Microfluidics

conservation of mass, momentum reynolds number

#### 2.1.1. Flow Field inside Microchannels

Navier-Stokes-Approximation for Hagen-Poiseuille

#### 2.1.2. Particles in Microfluidics

Stokes Drag Force Gravity Magnetic Force Friction Interface-Forces

#### 2.1.3. •

### 2.2. Surface Chemistry

#### 2.2.1. Carbodiimide Crosslinker Chemistry

EDC-NHS-Activation sulfo-NHS vs. NHS

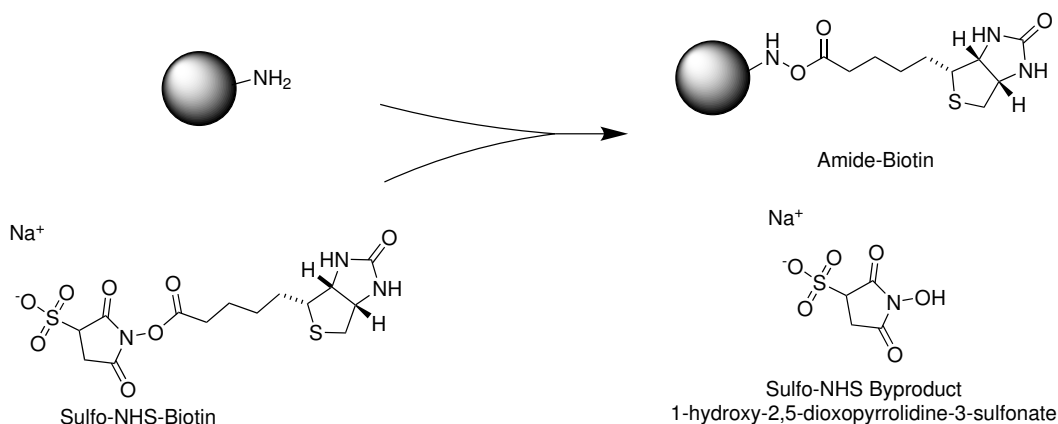


Figure 1 TestSvg

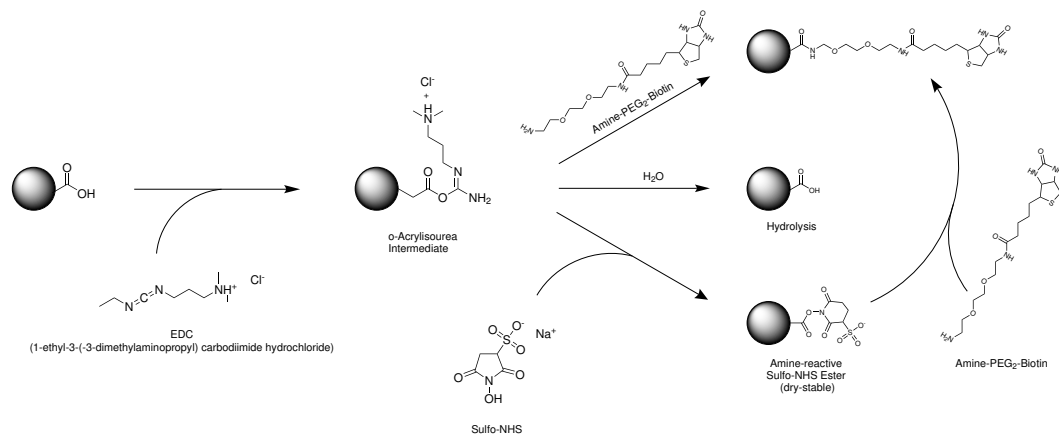
### 2.3. MRCyte

Short intro over MRCyte Foto of setup with arrows to necessary parts Microscope

Stages PEEK holder Helmholtz coils Kepco MFLI DAQ

#### 2.3.1. Focusing Structures

test,test



**Figure 2** TestSvg

### 2.3.2. GMR

Different produced GMR stacks Wheatstone Bridge setup Magnet alignment

### Hysteresis Alignment

test,test

### 2.3.3. Electrical Circuit

Ground PCB Stacked PCBs with spacer

### 2.3.4. Electronic Readout

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### Single GMR

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### Dual GMR

one MFLI supplies both at same frequency. Aux Trigger tested, but no advantage.

### 3. Materials and Methods

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## 4. Results

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### 4.1. Titration of reference bead surface coverages

#### 4.1.1. **Amine-Surface Biotinylation**

#### 4.1.2. **Carboxy-Surface Biotinylation**

### 4.2. Protein Immobilization on the Microfluidics bottom

#### 4.2.1. **Physisorption**

#### 4.2.2. **Covalent Attachment**

## 5. Discussion

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## 6. Outlook



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I declare that I have authored this thesis independently, that I have not used other than the declared sources / resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

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Munich, December 4<sup>th</sup>, 2020, Signature