Redesign of the Construction and Increase in the Performance of the Peripheral Devices of a Micro Mass Spectrometer

Hamburg University of Technology Institute of Microsystems Technology



Bundesministerium für Bildung und Forschung

Forschungszentrum Karlsruhe (PTKA)

Presenter: Régulo Miguel Ramírez Wong regulo.ramirez@tu-harburg.de

Technische Universität Hamburg-Harbur



Implementation

Overview

- Motivation
- Applications
- PIMMS
- Redesigns
 - Electron source
 - Signal generator for SIS
 - Ion current measurement
 - Vacuum chamber
- Measurements
- Outlook





Motivation

- Demand for a cost-efficient and portable device for analytic applications
- Market launch of a fully integrated mass spectrometer using microsystems technologies
- Increase of performance
 - higher resolution
 - lower run-time
- Very low sample volume requirements
- Process vacuum regime







- Rapid in-situ monitoring of industrial processes
- Real time analysis of exhaust gases
- Harsh-environment analysis
- Homeland security
- Space and aeronautics









PIMMS

- <u>Planar-Integrated Micro</u> <u>Mass Spectrometer</u>
- Dimensions 7x10mm²
- Fabrication using only MEMS technologies







Redesigns – Electron Source

Dark-space reduction by maniparea ratio between electrodes



- Electron yield improved from 2.5µA to ~37µA
- Power consumption ~200mW







Redesigns – Signal Generator for SIS







Folie 7

- 4 Signals
- Rise time < 1ns</p>
- DC-50 MHz frequency range
- Resolution < 0.1 Hz</p>
- Linear scan of frequency or mass possible





- High input impedance current to voltage converter
- Time constant < 3ms</p>
- Extremely low noise < 0,2pA</p>







Redesigns – Vacuum Chamber

2008





2009

Motivation – Applications – PIMMS – Redesigns – Measurements - Outlook



> Decision

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Redesigns – Vacuum Chamber

PIMMS PCB



Vacuum vessel



- Spatial separation between electronics and capillaries
- Vacuum chamber volume reduced (0,5L)





Measurements



- CO₂ 44u 0,04%
- Xenon:
 - Xe 131u (129u,132u)

Detection limit below 400ppm



Measurements

PIMMS			_ & ×
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Einstellungen		🖌 🏭 Hauptanzeige: Spektrum	
Manueller Modus Vorbereitung der Messungen Fokus und E-Filterspannur MCP Spannung MCP Sp. Interlock MCP Sp. Start Frequenz [MHz]: (5 - 50) Start Masse [amu] (11.58 - 1157.78) 49.995 11.58 Stop Frequenz [MHz]: (5 - 50) Stop Masse [amu] (11.58 - 1157.78) 20.335 70.00 Auflösung Messungen / [amu] (1 - 169) 169 Wartezeit [ms] 2 DC Offset [V] Wanderfeldamplitude [V]	IO Mess Modus Peripherie Scripts		
3.00 2.94 5.00 Vorbereitung der Messung:	0.9600	Sekundäranzeige: Messstrom LiveView 59.00 49.00 39.00 29.00 19.00 9.00	



Μικκο

SYSTEM**T**ECHNIK

Motivation – Applications – PIMMS – Redesigns – Measurements - Outlook



Folie 12

Outlook

- Frequency generator f>200 MHz
- Further reduction of chamber volume
- Integration of:
 - Injection system
 - Pumps
 - Electronics
 - Secondary electron multiplier
- Increase of:
 - Mass scan region 1 to > 200
 - Mass resolution > 50
 - Sensitivity < 100 ppm







thank you.



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