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## Nanotechnology: Applications in Medical Devices

**Alessandro Grattoni, Ph.D.**  
Chairman and Professor,  
Department of Nanomedicine  
Houston Methodist Research Institute, Houston



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## HMRI Department of Nanomedicine



**Houston Methodist Research Institute**

- Hospital Based
- 8-year old
- Conceived for translational research
- In the heart of TMC
- from its inception focused on:  
Cutting-edge technologies  
Service to the community

**Department of Nanomedicine**  
Total Personnel: 120  
Faculty: 13  
Research Associates, PhD: 29  
Graduate & Undergraduate Students: 45  
Research Assistants: 26  
Admin Staff: 7

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## Nanotechnology Platforms

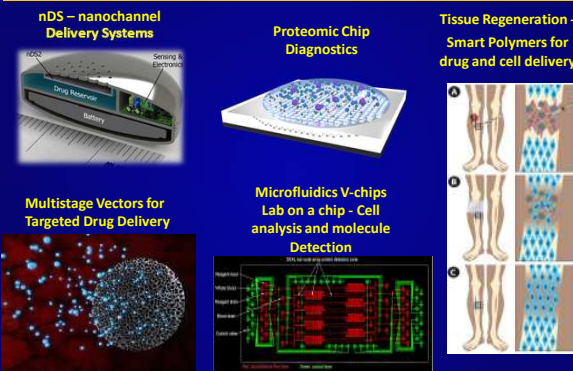
**nDS - nanochannel Delivery Systems**  
Sensing & Electronics  
Drug Reservoir  
Battery

**Proteomic Chip Diagnostics**

**Tissue Regeneration - Smart Polymers for drug and cell delivery**

**Multistage Vectors for Targeted Drug Delivery**

**Microfluidics V-chips Lab on a chip - Cell analysis and molecule Detection**



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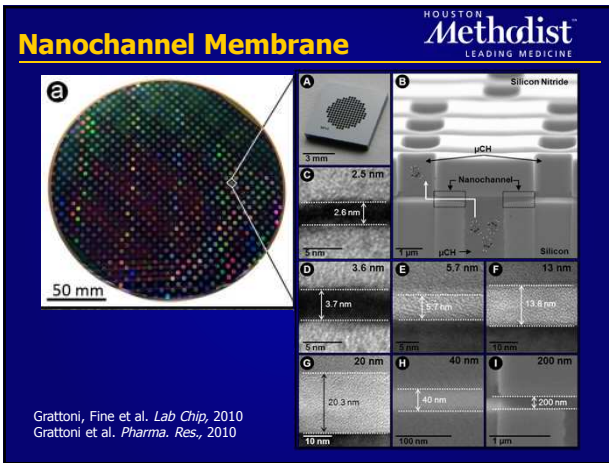
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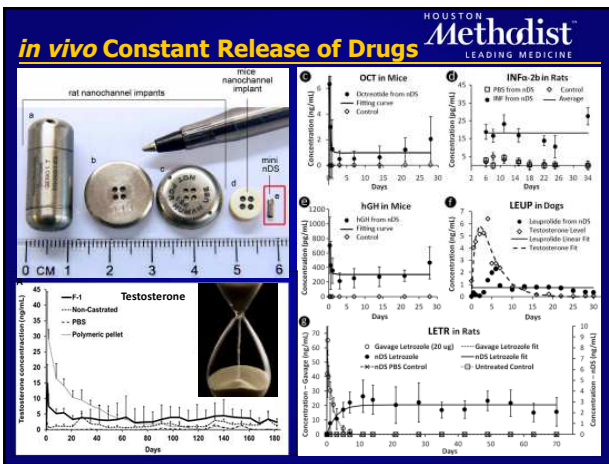
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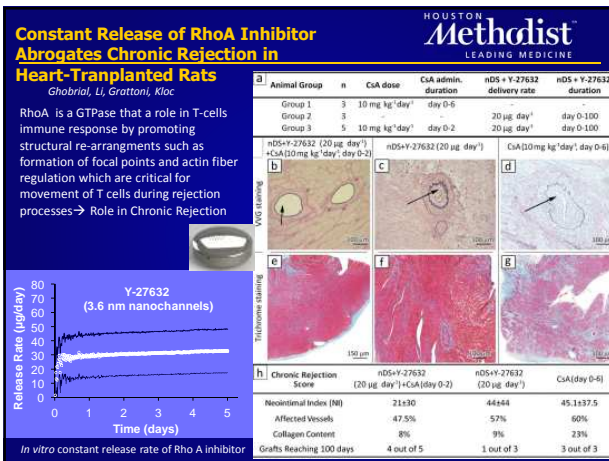
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### Remotely Controlled Drug Delivery

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Implantable Sensor-Drug Delivery Network

**Aim 1: Tunable Controlled Delivery**

**Aim 2: Bioresponsive Delivery**

On-Earth clinical applications | Telemedicine | **in vivo testing capability enhancement on-ISS**

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### RF-Remotely Controlled nanochannel Delivery System (nDS2)

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Membrane housing | Drug Reservoir

Bluetooth Circuit | Battery

Released Amount (µg) vs Time (h) for DF-1 and Methotrexate

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### Point of Care Diagnostics

Lidong Qin Group Research

Point of Care Biomarker Analysis | High-Throughput Single-Cell Analysis | Cell Mechanics and Deformability | Cell Migration and Invasion

Lab Chip 2015, Anal. Chem. 2015, Trends Biotechnol. 2014, Angew. Chem. Int. Ed. 2014, JACS 2013, Nat. Commun. 2012

PNAS 2015, J. Immunol. 2015, PNAS 2014, JACS 2014, Sci. Rep. 2012

Sci. Adv. 2015, Sci. Rep. 2015, Sci. Rep. 2013, PNAS 2012

Angew. Chem. Int. Ed. 2015, Sci. Rep. 2015, Integr. Bio. 2015, JACS 2014, Angew. Chem. Int. Ed. 2013

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**Proteomic Nanochip for Low Molecular Weight Protein Detection:**

**Silicon Nanoporous Substrates**

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**Nanotrap-Enabled, Functional Mechanism-Based Method for the Early Diagnosis in Cancer Diseases**

**MINING THE HIDDEN PEPTIDOME**

- To discover the new biomarkers for early diagnosis and prognosis
- To reveal the enzymatic network in tumor microenvironment
- To track the chemical reaction in tumor progression

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**Multi-Stage Drug Delivery System: Mesoporous Silicon Microparticles**

**nature nanotechnology**

Beating barriers with multistage delivery

SILICON NANOCRYSTALS Seeing the light

MAGNETIC NANOPARTICLES Remote control for cells

MOLECULAR ELECTRONICS DNA proves its potential

**LETTERS**

Mesoporous silicon particles as a multistage delivery system for imaging and therapeutic applications

ENRICO TASCOTTI\*, XUEJUN LIU\*, ROHANI BHAIANEE\*, KEVIN PLANITZ, ASHLEY D. LEONARDI\*, B. KATHERINE PRICE\*, MARK MING-CHENG CHENG†, PAOLO DECUZZI‡, JAMES M. TOUR†, FREDRICK ROBERTSON§ AND MAURO FERRARI¶\*\*

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