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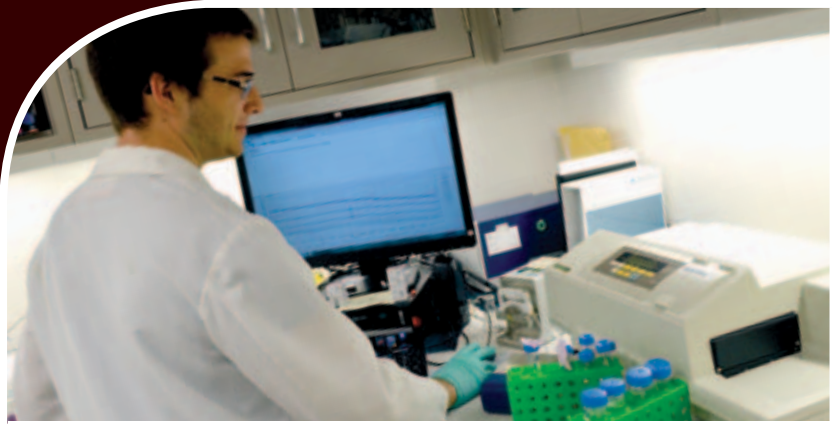
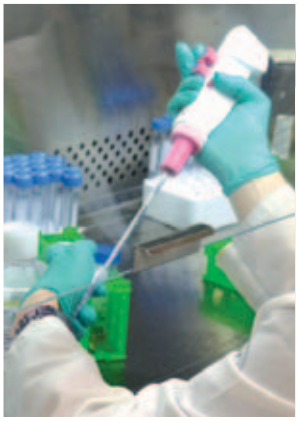
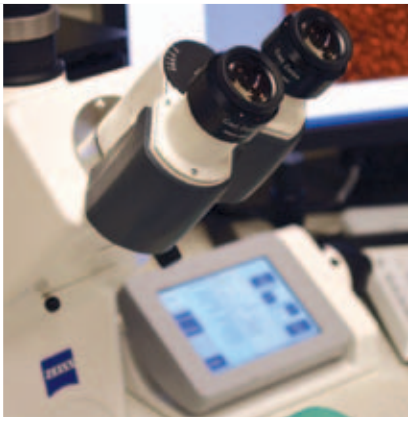
Advanced Platform Technology Center

A VA Research Center of Excellence







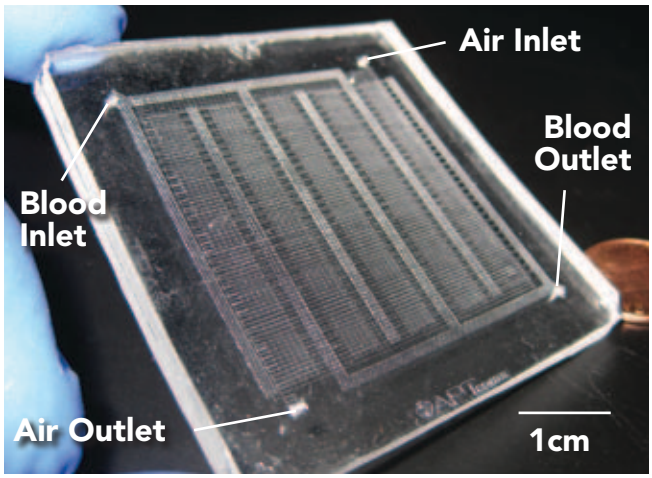
PROJECT OVERVIEW

Microchannel Artificial Lung

The long-term goal of this project is to improve the rehabilitation of patients with acute and chronic lung diseases through the development of the first truly portable, biocompatible, artificial lung capable of short and long term respiratory support. The objective of the current research is to fully characterize the *ex vivo* gas exchange properties and lifetimes of microfabricated artificial lungs with feature sizes and physiological properties approaching that of the human lung.

The proposed artificial lung technology has the potential to significantly enhance respiratory rehabilitation through: 1) Improved gas transfer performance to enable complete respiratory support, 2) Increased biocompatibility to extend device lifetime suitable for long-term treatment, and 3) Unprecedented portability to enable ambulatory care for greater patient quality of life. Medical devices incorporating this technology would provide lung rest for patients suffering from acute and chronic pulmonary disabilities, serve as a bridge to transplant for patients with chronic lung disease or lung cancer, and eventually lead to the first implantable artificial lung for semi-permanent support.

We have demonstrated that our artificial lung technology has the highest efficiency of any device to date. Furthermore, we have developed a surface modification that improves blood compatibility and will enable use of the device in acute clinical applications. Planning for initial animal experiments is underway.



A photograph of the artificial lung showing blood and air inlets and outlets and the microfluidic channels comprising the device. A penny is shown in the background for scale. The artificial lung contains blood channels that are similar in size to those in the natural lung.

APT Center Contributions:

- Access to clinical staff for critical input
- Design controls and documentation within a quality system to facilitate future commercialization
- Access to microfabrication facilities and expertise
- Start up and bridge funding

Project Funding History:

US Department of Veterans Affairs, Merit Review, 7404R, April 2011 – March 2014

US Department of Veterans Affairs, VISN 10 Research Initiative Program, October 2007 – September 2008

Selected Publications:

"A simple, closed-form, mathematical model for gas exchange in microchannel artificial lungs," J. Potkay, *Biomedical Microdevices*, Vol. 15, No. 3, pp. 397-406, 2013.

"A Hybrid Thermopneumatic and Electrostatic Microvalve with Integrated Position Sensing," J. Potkay and K. Wise, *Micromachines*, Vol. 3, No. 2, pp. 379-395, 2012.

"Bio-inspired, efficient, artificial lung employing air as the ventilating gas," J. Potkay, M. Magnetta, A. Vinson, and B. Cmolik, *Lab on a Chip*, Vol. 11, No. 17, pp. 2901-2909, 2011.

"Long term, implantable blood pressure monitoring systems," J. Potkay, *Biomedical Microdevices*, Vol. 10, No. 3, pp. 379-392, 2008.

"A Low Power Pressure- and Temperature-Programmable Micro Gas Chromatography Column J. Potkay, G. Lambertus, R. Sacks, and K. Wise," *IEEE Journal of Micro Electro Mechanical Systems (JMEMS)*, Vol. 16, No. 5, pp. 1071-1079, 2007.

The **APT CENTER** is a Department of Veterans Affairs Rehabilitation R&D Center of Excellence that creates novel, cross-cutting technologies for the diagnosis, treatment or study of high priority clinical conditions within a structured framework that facilitates regulatory compliance, dissemination within the rehabilitation community and commercialization by outside manufacturers. Center projects focus on the following: prosthetics and orthotics, health maintenance, neural interface and enabling technologies. The Center has over 30 investigators, engineering and clinical staff, and support services including regulatory affairs, quality systems, project management and grants administration.

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