UTAH NANOFAB

**“An extension of your own lab capabilities”**

# nanoUtah ‘15

13 October, 2015

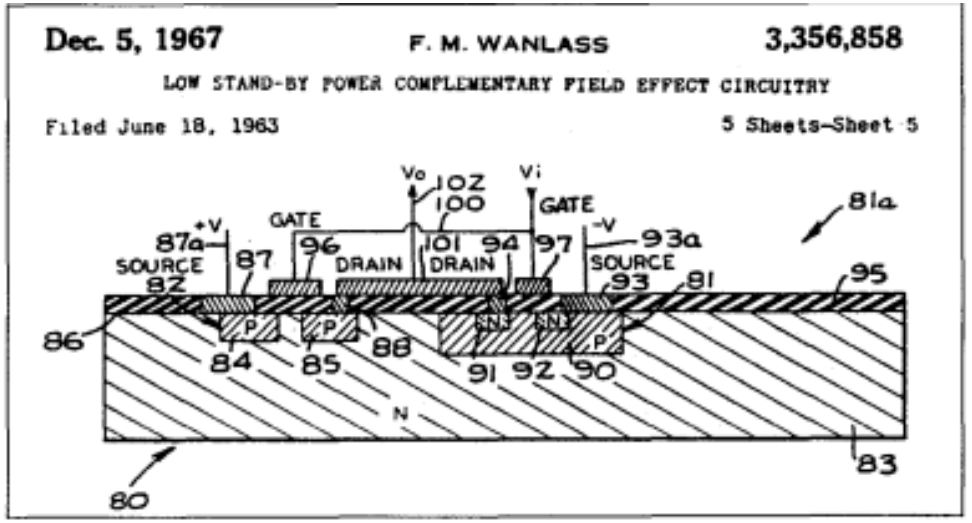
Ian R. Harvey, Associate Director

UTAH NANOFAB

# History

**1967: Frank Wanlass**

**(General Instruments - SLC)**




*Wanlass's patent portrayed an integrated CMOS inverter.*

**1969:** Willem Kolff establishes first thin film capability supporting artificial organ research

**1976-2001:** HEDCO Microelectronics Laboratory: General Instruments tool donation

**2001-2011:** Utah Microfab focusing on implantable devices, MEMS and microelectronics

**2004-2011:** Surface Analysis & nano Imaging Lab (add XPS, SEM, FIB, AFM, Ellipsometry, Zygo)

**2012-present:** Transition to Utah Nanofab:  ISO 4,5,6 (with ISO 5, BSL-2 bio bay), add new PECVD stack, 2nd DRIE, w/d ox, sub-micron litho, RTP

**2012-present:** Micron Microscopy Suite: 5,300 $ft^2$ adds FIB, TEM fast mapping tomo…

Prior to 

, How did the  stack up?

Increasing Microscopy Capability Awesomeness

Increasing Cleanroom Capability Awesomeness

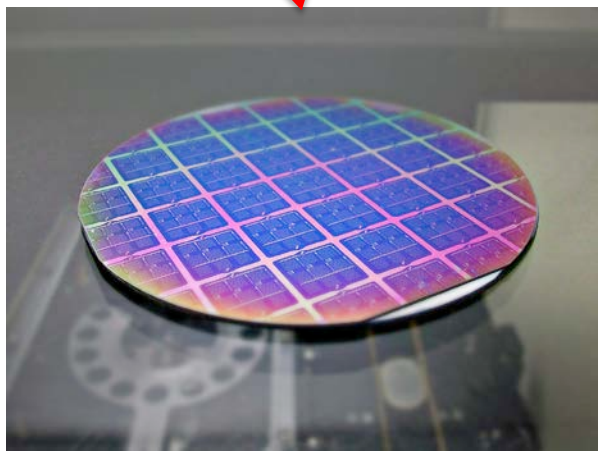
UTAH NANOFAB

## Cleanroom

thin film patterning • microfluidics • laser & wire EDM μmachining • microsystems packaging

## Surface Analysis & nanoImaging

Correlative multi-scale analytical microscopy

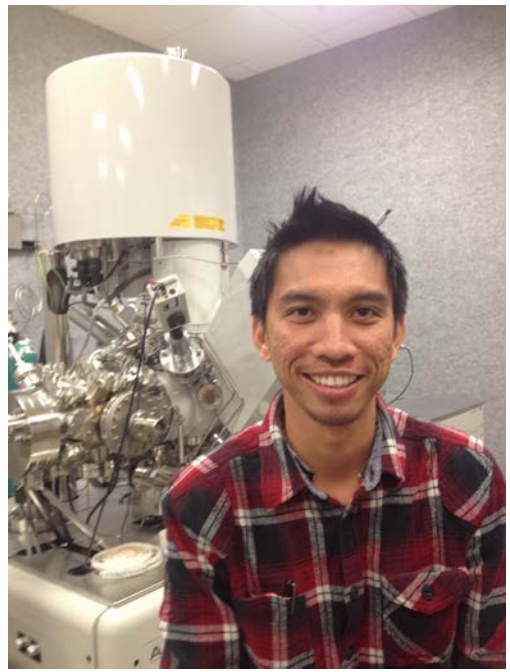


## Center for Engineering Innovation

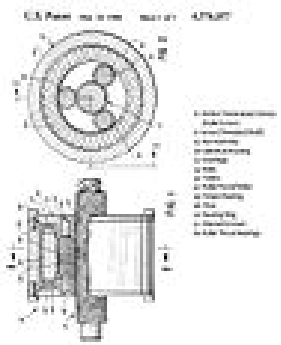
sensors • actuators • system prototypes • advanced packaging

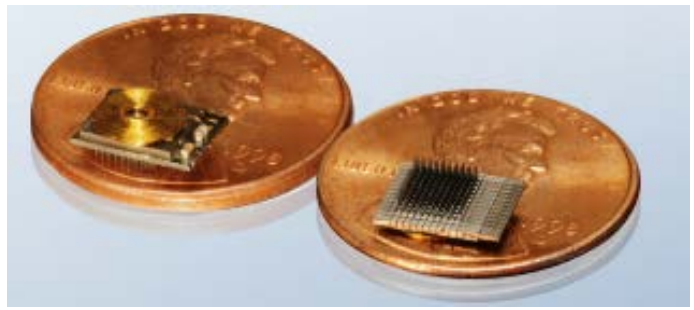
# We supply critical…

…infrastructure …tools and instruments…expertise



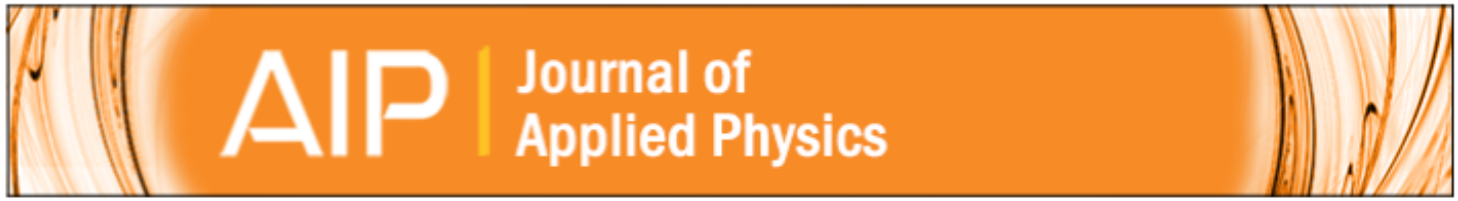
**to support R&D success.**



# How Staff Interact…

- Train students to do their own work
- Provide analysis services and data interpretation
- High technical trust and interaction justify co-authorship




**Surface stoichiometry of pulsed ultraviolet laser treated polycrystalline CdTe**

Brian J. Simonds, Vasilios Palek s, Brian Van Devener, Chr stos Ferekides, and Michael A. Scarpulla

Citation: Journal of Applied Physics **116**, 013506 (2014); doi: 10.1063/1.4887079

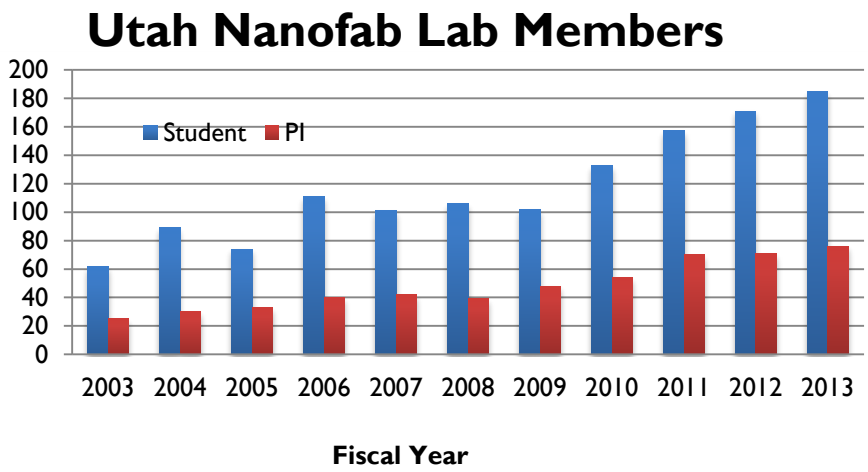



# Ultra-high-efficiency metamaterial polarizer

BING SHEN,[1] PENG WANG,[1] RANDY POLSON,[2] AND RAJESH MENON[1,*]

# Nanofab access cost kept low by subsidy (VP-R, Dean COE, USTAR)

- 24/7 operation user facility
- On-line or mobile scheduling
- Real-time cost/burn-rate tracking
- Low per-tool hourly rates (now the same across-the-state)
- Preliminary Data Seed Fund (3 months tool use reimbursed)
- Student projects funded (Ph-I full subsidy; Ph-II cost-shared)




# Recent Equipment Additions

- Hi-resolution S/TEM
  - Ultrafast EDS for 2D mapping with hi-res imaging
  - 3D tomographic mapping
- LPCVD furnaces
- Heidelberg sub-μm mask making tool (900nm direct write)
- Wet/dry oxidation (lesson on don't buy based on price tag alone)—Loss of solid source doping capability
- Rapid thermal annealing (ETA Oct/Nov)
- Chilled finger for parylene (no more $LN_2$!!)
- Keyence 3D measuring microscope

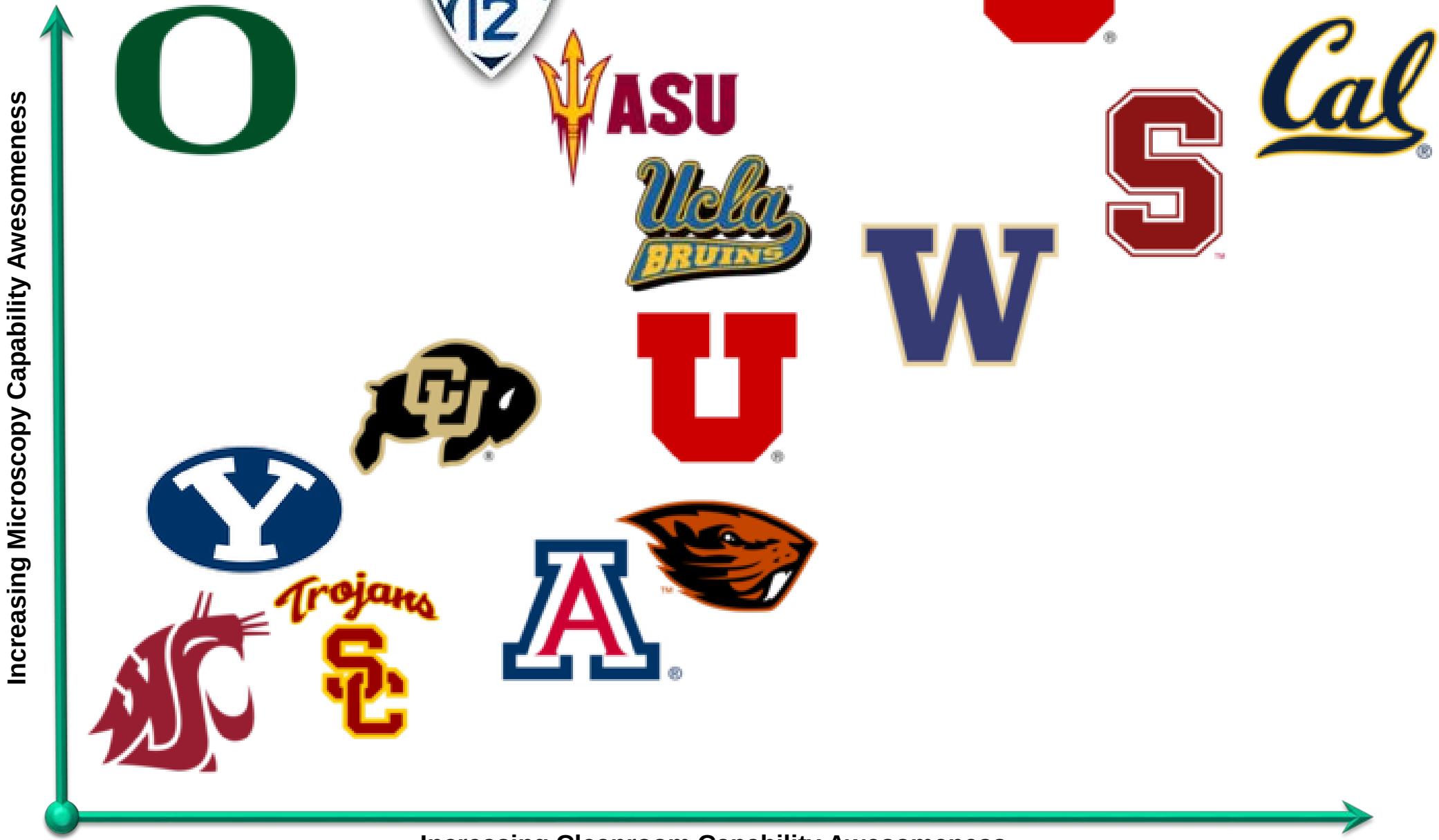
# Tool Roadmap

- Advanced Reactive Sputtering tool (USTAR-pending)
- Toxic materials sputtering (VO2, other)
- Si DRIE / poly etch
- Metal etcher
- Glass DRIE
- EV 620 advanced lithography tool
- Metal ALD
- PECVD
- Nanoscribe (nano 3DP)
- EELS
- EBL

# Selected to host UGIM ’16

## world conference of peer research cleanroom adminstrators

# Welcome to the ! How does the stack up?



UTAH NANOFAB
College of Engineering | The University of Utah

Nanofab.utah.edu






## New nanometer scale 3D tomography

Sep 03, 2015

The Surface Analysis lab is pleased to announce the addition of 3D imaging and elemental mapping tomography to its high resolution S/TEM, the JEM-2800.

Through a collaboration between the U, S/TEM manufacturer JEOL and developer App5, we add another first-of-its-kind among academic institutions: the ability to map elemental compositional distributions in 3D. This is done by reconstructing images taken during a tilt series in STEM mode, including both structural information and EDS information. This is only feasible because of the extremely efficient collection of x-rays through the use of the large-area dual detectors configured on this microscope. For more information, see Dr. Brian Van Devener, Dr. Randy Polson, or Dr. Paulo Perez.

# Proposal Writing Support

Click here for the Preliminary Data Seed Fund

Click here for Nanofab **Equipment List**

Click here for images and descriptions of specific fab tools

Click here for images of the building, surface lab instruments, some representative research images

How to cite the lab in your publications

# Lab Description

Also see "Overview" page

Utah's micro and nano science and engineering laboratories are interdisciplinary facilities supporting innovativ
transfer. Located at the University of Utah, these multi-purpose facilities provide the clean environment, exper
micromachining, microfabrication, and nano-scale semi-conductor materials& device research.

The teaching laboratories strengthen undergraduate microfabrication curricula and train graduate students fro
in the fundamentals of micromachining, microsystems design and characterization, microsensors and actuator

Premise: Our ability to create new sensory, actuation and control micro devices is severely restricted if we limit ourselves to design tricks and scaling effects.

➔ We have to be able to add to that **NEW MATERIALS.**

Cross-contamination

Toxic

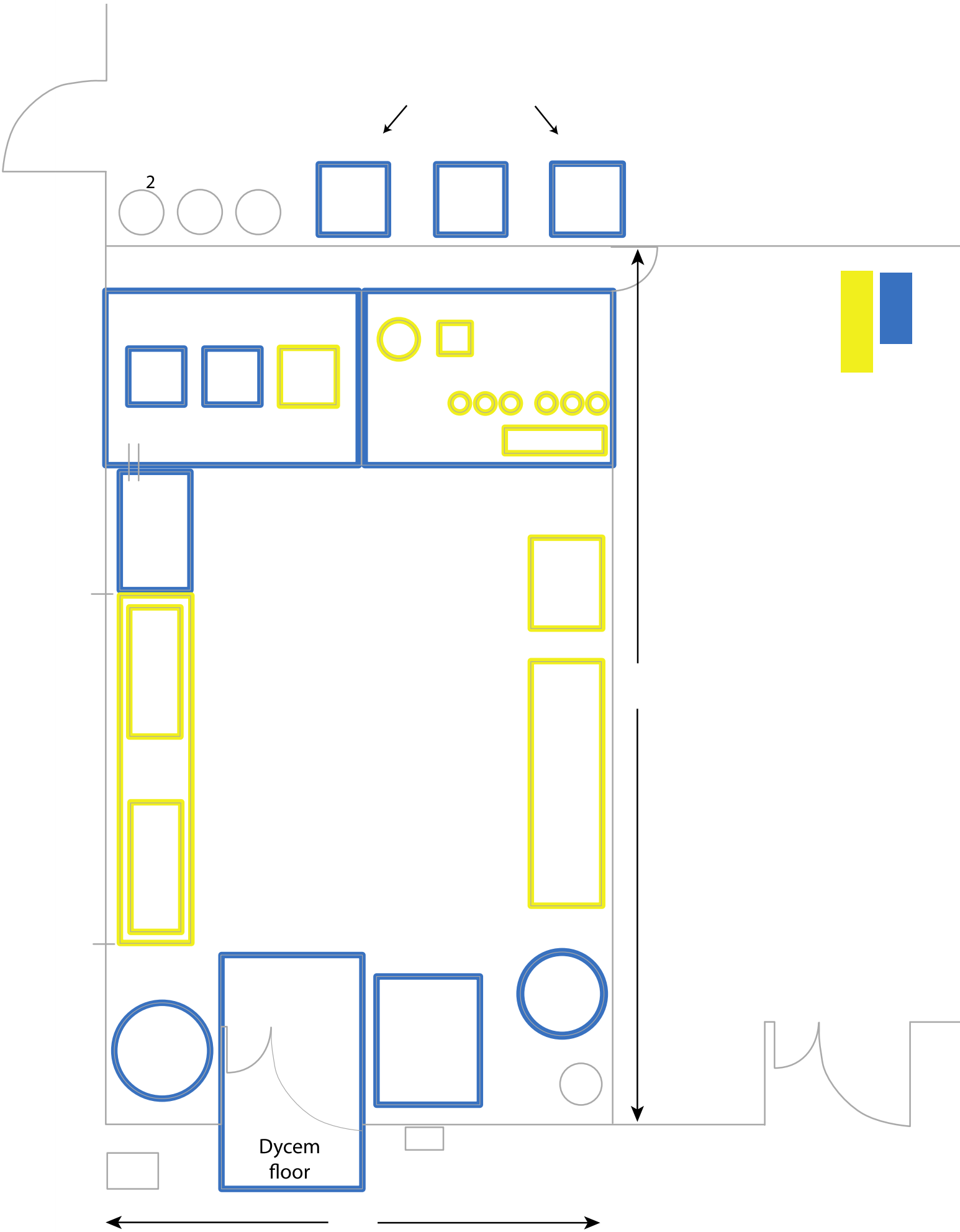
difficult to handle

Desktop Pro control cabinet with:

- DC power supply
- RF Power supply
- 2 Cathodes
- MFC
- »disposable » Pumps
- Replaceable chamber

$VO_2$

PZT…


2
Dycem
floor