



# XIDAS

innovate. **smaller.**

## SMALL is BIG!

Next generation integrated microfluidic devices  
for industrial and life science applications



# Xidas technology

Xidas makes the world's smallest electromechanical valves, pumps, fluid sensors, and fluidic modules

Xidas can do this because we use a unique (patented) manufacturing paradigm called "Amalga", which allows us to perform micro-integration of electrical, mechanical, and fluidic systems during manufacturing, using fabrication infrastructure from the electronics manufacturing industry.

Thanks to Amalga, Xidas makes microfluidic products that have unique functionality, high performance, small size, and low cost.

We use these components to build small, high-value fluid systems that could not exist before, solving big problems for industrial, life science, and healthcare customers.

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**UCI** University of California, Irvine

*Xidas is a spin-out company from the University of California Irvine. Xidas leverages technology that was developed from over 15 years of development and millions of dollars of research funding by some of the leading labs in microfabrication research. Xidas's unique technology solves one of the most important roadblocks in miniaturization—integration of materials and technologies at the micro scale.*

CEO/CTO

Life science applications

Industrial applications

Manufacturing



Mark Bachman



Phil Duncan



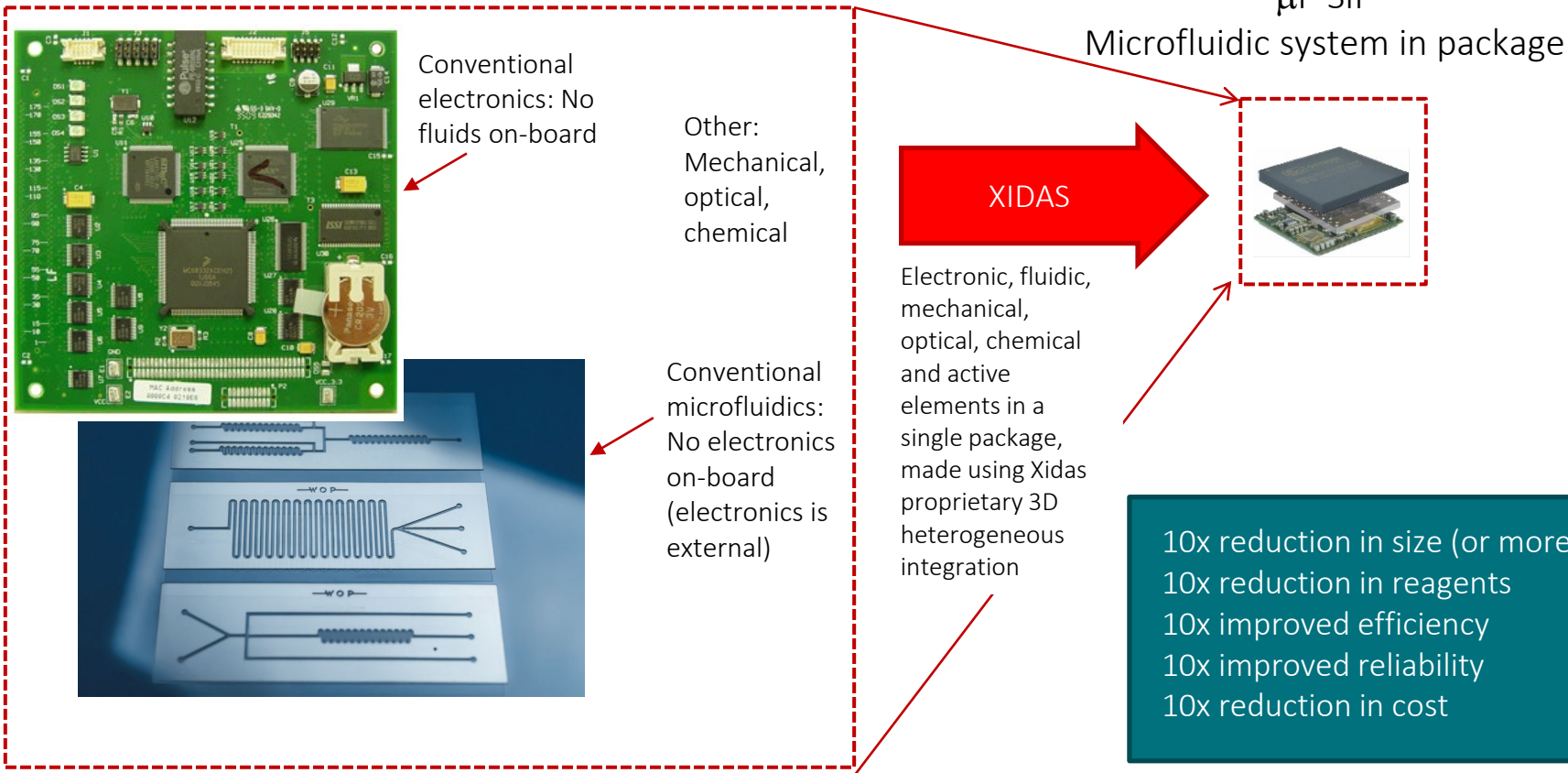
David Ambrose



James Harvey

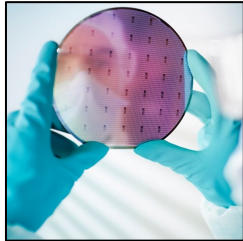
**Xidas Technical Leadership**

# Xidas paradigm: Electronic, fluidics, and MEMS in a package



# Building small things using microelectronics 3D packaging

## Conventional miniaturization



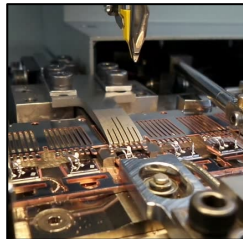
### Semiconductor manufacturing

High precision, but cannot integrate dissimilar materials, cannot use different fabrication processes, cannot build 3D structures



### Precision manufacturing

High precision, but difficult to integrate different materials. Extremely difficult to scale to large volumes.



### 3D heterogeneous integration

Low cost precision assembly-based fabrication. Used for packaging and stacking microelectronics—has never been used to make devices (except for UCI).

## Xidas Amalga process

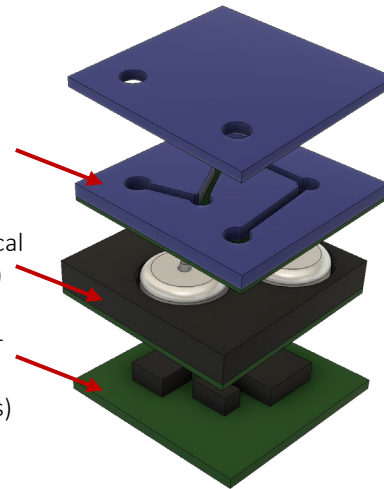
Combines all three micro-manufacturing processes into a single manufacturing approach

Example:  
Micropumps

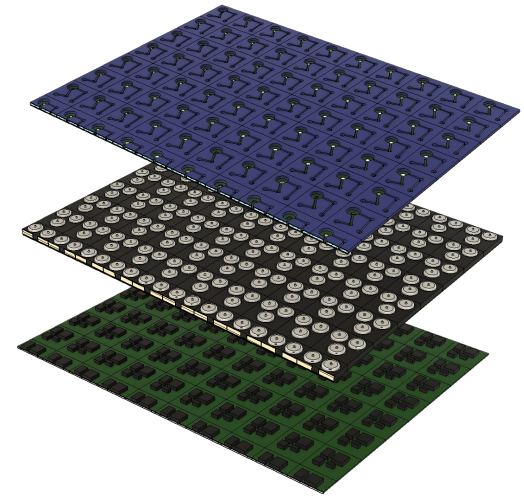
Fluidics layer  
(channels and membranes)

Electromechanical  
layer (actuators)

Electronics layer  
(including microprocessors)



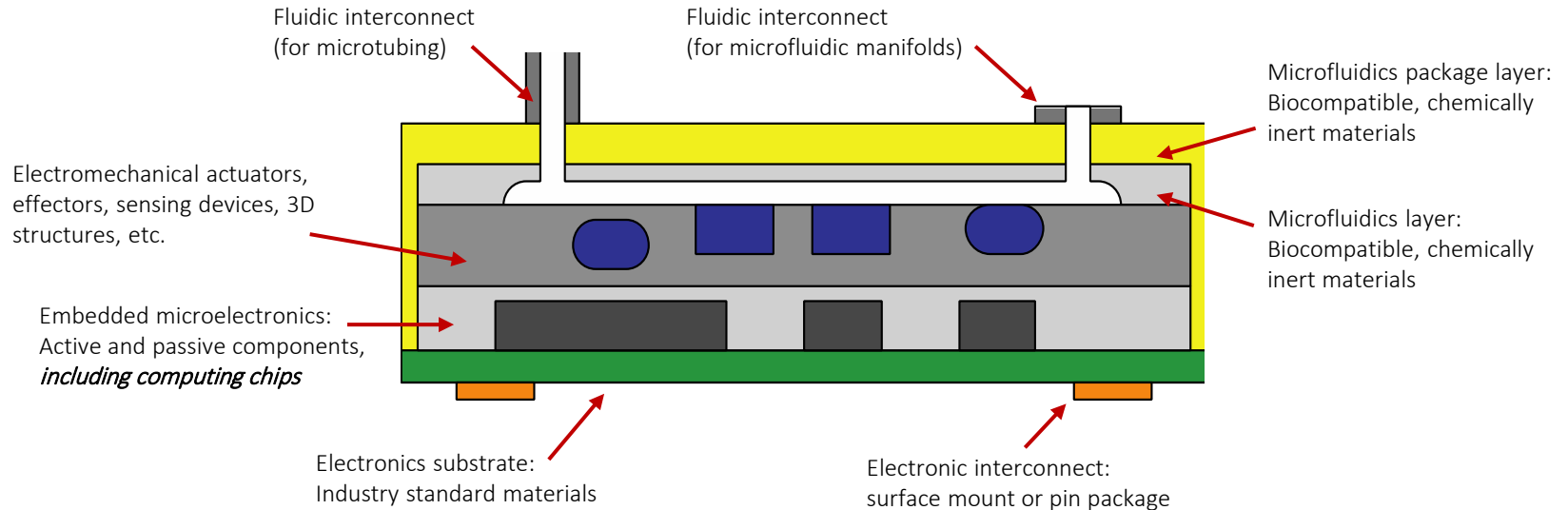
Complex, heterogeneous  
3D topology



Panel-level assembly

Uses heterogeneous integration and other manufacturing processes, enabling a wider choice of materials and processes. Highly three-dimensional, highly integrated. Layers fabricated independently improving yield. Already packaged device, reduced cost and time to develop. Large manufacturing infrastructure—fabless production is possible.

# Result: Small, smart, highly integrated devices



## Anatomy of a Xidas microfluidic component

Xidas integrated microfluidic devices (components and modules) are highly integrated products that contain multiple technologies and enable standard connections to be made to electronics and fluidics.

*Xidas is the only company in the world that makes microfluidic devices this way.*

# Xidas's small, smart electrofluidic devices have big value

## Life Sciences

Medicine, pharmaceuticals, in vitro diagnostics, health and beauty



Micro-assays, micro-incubators, micro-dispensers, microsensors.

## Industrial IoT

Food production, agriculture, mining, steel, pulp/paper, energy



Smart fluid and chemical sensing, portable assays, wireless and wired, IoT/cloud ready.

# Micro fluidic controllers: pumps and valves

## A variety of pump and valve designs are possible

Xidas has studied and demonstrated dozens of microfluidic controllers.

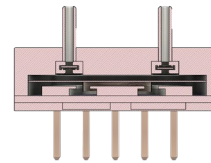
**Micro-pump technologies:** electro-osmotic pumps, osmosis pumps, electrolysis pumps, heater pumps, piston pumps, screw pumps, bubble pumps, membrane pumps, peristaltic pumps, magneto-hydrodynamic pumps, and moving surface pumps.

**Micro-valve technologies:** include check valves, pinch valves, ball valves, bubble valves, membrane valves, latching valves, hydrophobic valves, sacrificial valves, hydraulic valves, diffuser valves.



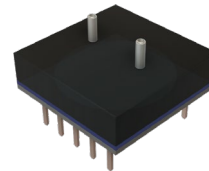
Electro-osmotic pump

Xidas has expertise in a large variety of microfluidic pump technologies. This example is a small electro-osmotic pump that uses low voltage to electrically drive fluid through nanopores.



Membrane pump

Xidas applies its expertise in microactuators to build small versions of conventional pumps, such as membrane pumps. Non-conventional pumps are often more suitable for microfluidics.



Latching microvalve

Xidas applies its expertise in electromagnetics to build small valves. This example is a latching valve that works similar to a solenoid valve, but requires no energy to stay in its “on” or “off” state.

# Micro fluidic sensors: pressure, physical, electrochemical

## A variety of small volume sensors

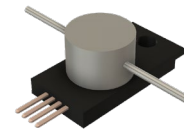
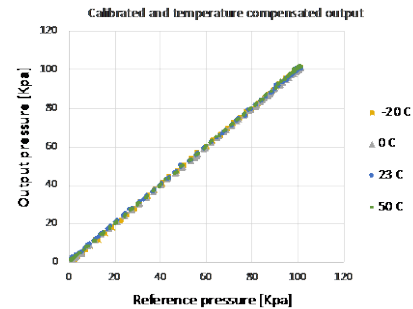
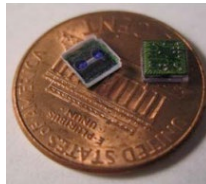
Xidas has studied and demonstrated dozens of microfluidic sensors.

**Pressure sensing:** Zero-dead volume inline pressure sensing, implantable zero-power wireless sensors

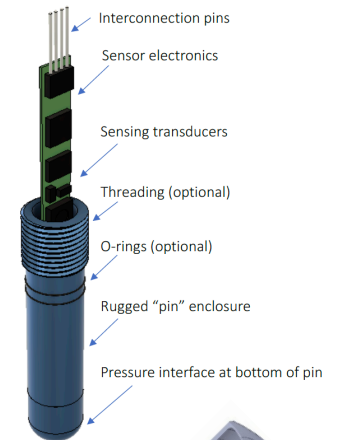
**Physical sensing:** Temperature, flow, level, turbidity, viscosity, refractive index, absorbance

**Electrochemical sensing :** Conductivity, impedance, voltammetry, amperometry, colorimetry, fluorescence, inline Coulter counting

Inline Coulter counter



Pressure sensor with 0.5mm ID



Xidas microfluidic sensors can be stand-alone smart components or can be packaged with other sensors and telemetry units to make small modules, such as wireless fluid sensors.



# Micro fluidic effectors: temperature, flow, filtering

## Microfluidic effectors

A number of effector technologies are available

**Temperature control:** Small volume inline temperate control with integrated sensor feedback, for applications in cell culture, cell lysis, and PCR

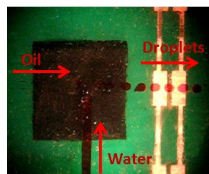
**Flow modulation:** Flow attenuators, droplet generators, continuous flow dosing

**Hydraulic flow control:** Micro-dispensing in a small package

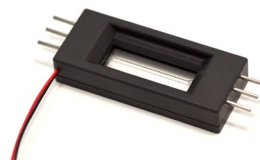
**Continuous flow filtering:** Continuous flow sieves, electrophoresis separation, dielectrophoresis flow filtering



Inline temperature controller



Droplet generator



Xidas inline microfluidic temperature controller uses embedded heaters and sensors to accurately control the temperature in a small volume of fluid.

Xidas droplet generator uses an embedded flow restrictor to modulate and control the droplet size in a microfluidic droplet system.

Xidas DEP sorter uses suspended 3D electrodes to create large electric field gradients that can be used to filter particles based on their polarization characteristics.

# X-Flow: precision dosing and metering in continuous flow systems

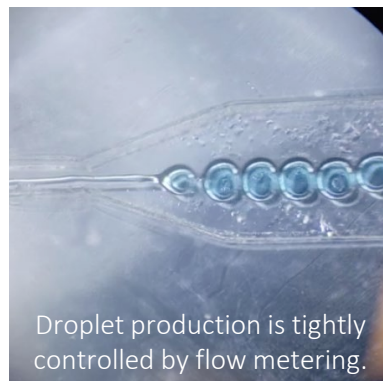
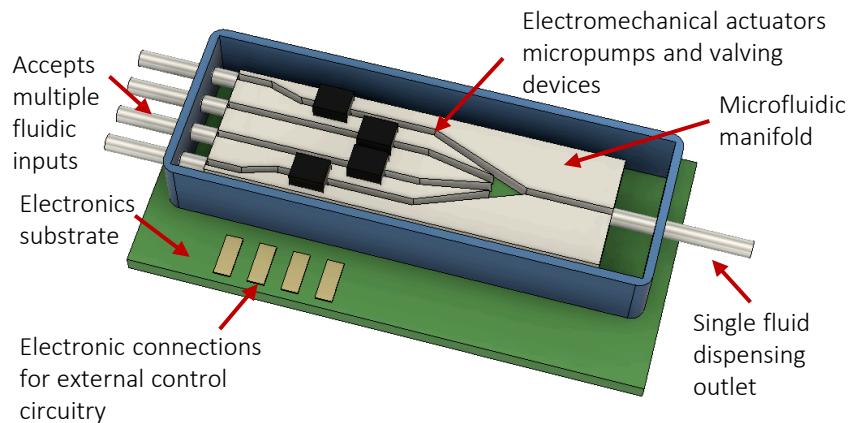
## Controlled flow dispensing

Xidas's X-Flow engine provides all the necessary elements to precisely control the flow of multiple fluid lines in a continuous flow system.

Xidas's electromechanical valves/pumps are used to control fluid flow that is blended together to form a single stream of fluid, with constituent fluids precisely controlled.

Applications include drug delivery, medical dosing, dynamic vaping, custom perfume, personalized skin care, micromixtures, droplet generation (for pharma screening).

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# X-Assay: universal assaying engine

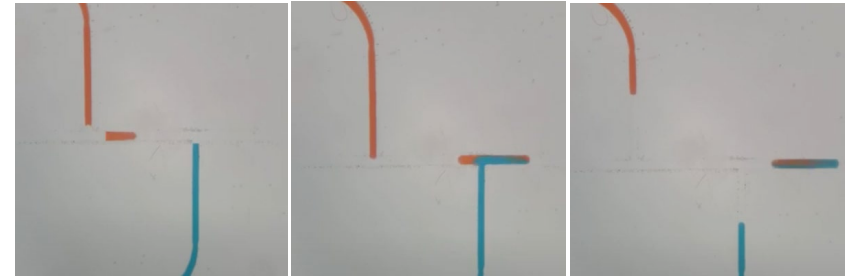
## Micro-metering and manipulation

Xidas's X-Assay engine is intended for performing a variety of chemical assays in a small footprint, using small amounts of reagents.

Xidas's electromechanical valves/pumps are used with immiscible fluid and hydraulic systems to precisely meter samples and reagents in a controlled manner. Imaging software is used to assist in assay control as well as for data readout.

A wide variety of assays can be performed using microliters of sample. Additional features are readily added, such as electrodes, filters, "hot spots" (for rapid microliter PCR).

XIDAS



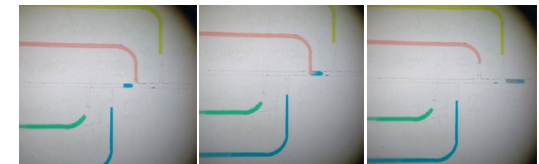
First sample dispensed into assay system

Second sample dispensed into first sample

Final sample moved to next step of assay. Mixing is easily accomplished.



Inexpensive cartridges may be used



Many channels can be controlled.

# FlowDEP: continuous sorting by dielectrophoresis (DEP)

## Xidas DEP sorting

Xidas has developed fluidic systems capable of efficiently sorting particles (such as cells) in a flow stream using high alternating electric fields. This technology was developed as part of a collaboration with a major US agriculture biotech company.

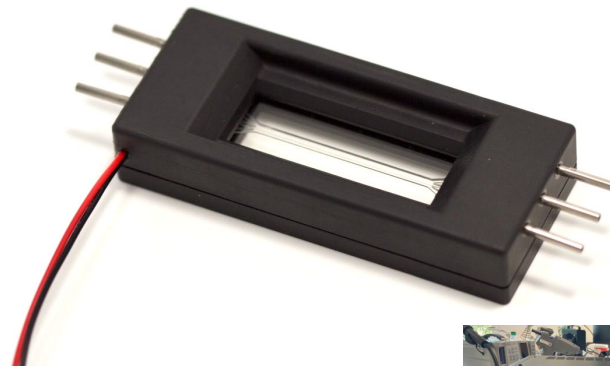
Xidas produces a variety of products to support development of DEP sorting protocols, including DEP power supplies, DEP characterization chips, computerized flow systems, and research-level DEP sorting chips. Xidas DEP products utilize 3D electrodes.

Once DEP properties and appropriate conditions have been identified, Xidas can provide industrial grade systems for automated large volume DEP sorting.

*Powered by Xidas's proprietary integrated microfluidics technology.*

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### **Xidas DEP flow cells for research:**

Small flow cells that can be observed under the microscope to enable appropriate DEP protocols to be determined. Xidas provides everything needed to determine DEP parameters, including flow control systems, high voltage / high frequency power supplies, characterization cells, and flow cells.

# X-Select: high throughput microtissue culture systems

## Xidas micro tissue culture technologies

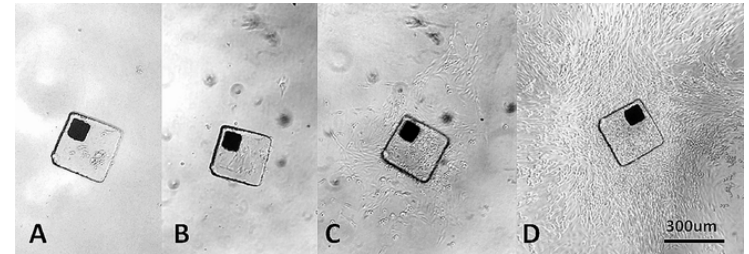
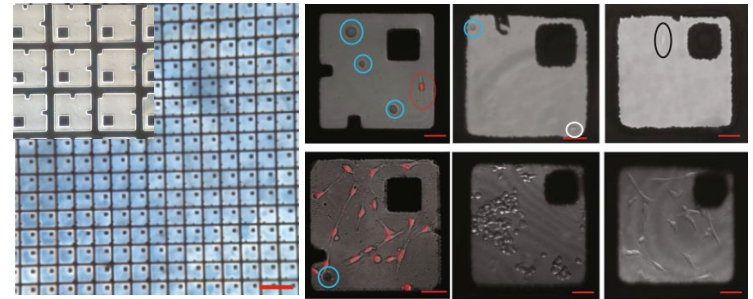
Xidas builds microarrays for doing high volume precision tissue cultures. Xidas tissue culture microarrays is based on 15 years of research at The University of California, Irvine.

X-Select utilizes thousands of small microcarriers that can be placed on an array plate for doing tissue culture. Cells (or colonies, organoids, etc.) can be cultured on the micro carriers and then selected for further study at a later time.

Carriers can be made from a large variety of materials and contain a magnetic materials on their perimeter, enabling easy removal from the array.

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### Xidas micro-tissue pallets:

Small containers (“pallets”) for growing colonies in microarrays, then selecting and transferring them to a secondary vessels for expansion and analysis.

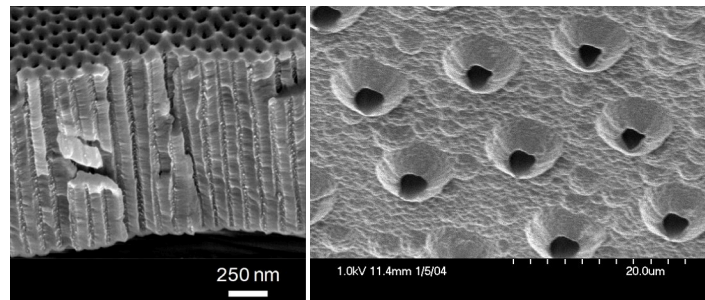
# X-Select: micro-membranes and magnetic rings

## Xidas micro-membrane structures

Xidas has a unique ability to create micromachined membranes with magnetic rings in large quantities. These micro-membranes may have various surface properties and porosities. 3D structures and electrical traces can be added to the membranes.

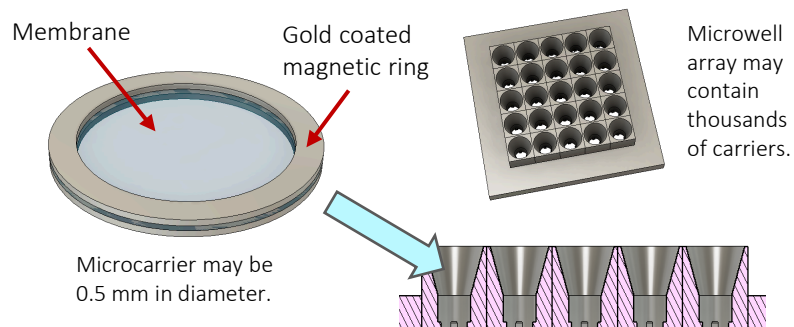
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Nanoporous Al<sub>2</sub>O<sub>3</sub>

Microporous polymer



### Xidas micro-tissue carriers:

Small carriers for growing colonies are placed in microwell microarrays where they are used to grow tissue. When appropriate, they are then selected (magnetically) and transferring to secondary vessels for expansion and analysis.

# FlowTab: scalable, versatile microtissue platform

## Xidas introduces FlowTab

The most scalable, versatile, easy to use microtissue culture and organ-on-chip system.

Leveraging experience and technology for microtissue culture, Xidas has developed a powerful “Organ-on-Chip” platform that can be used for a wide variety of microtissue cultures, from single experiments, to large scale automated studies.

Xidas’s FlowTab system empowers biologists to design countless different conditions for organoid and tissue studies, then perform them using inexpensive microfluidic micro-cartridges (FlowTabs) for use with a microfluidic controller or standard laboratory multi-well plates.

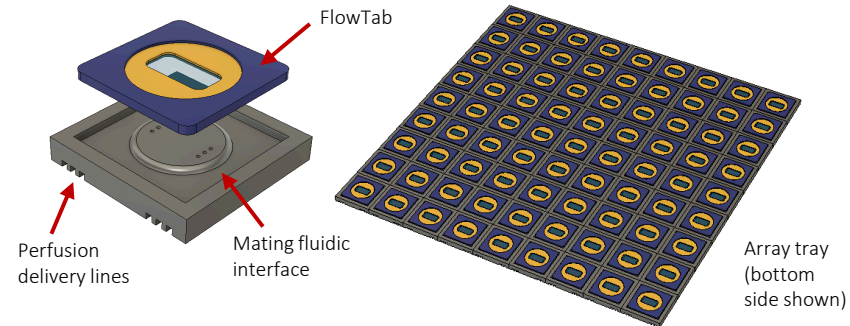
Organ microenvironments are completely configurable, programmable, and dynamic.

*Powered by Xidas’s proprietary integrated microfluidics technology.*



### Xidas FlowTab™ microtissue culture system:

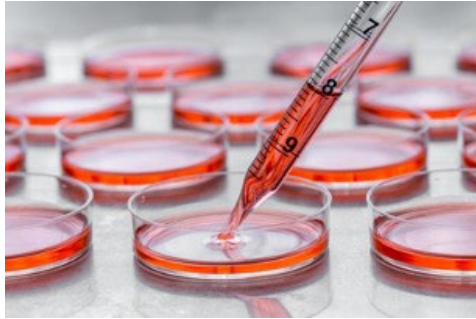
Puts custom Organ-on-Chip experiments inside low-cost micro-cartridges for use in microfluidic controllers and multi-well plates. Uniquely versatile and scalable.



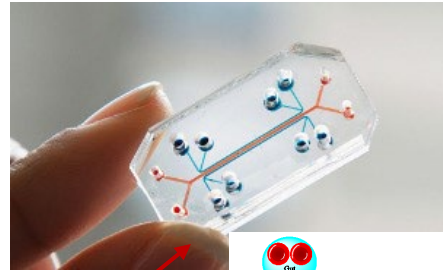
### Xidas FlowTab+ microtissue culture system:

FlowTabs can be designed for array trays, automated pick and place, and large scale fluidic control.

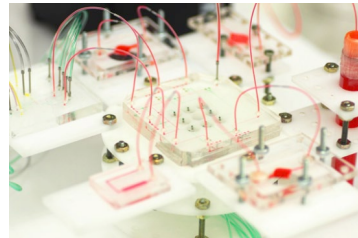
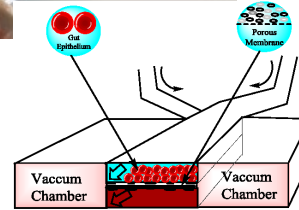
# FlowTab: scalable, versatile microtissue platform



Current ways of doing research with tissues is using conventional tissue culture or animal models. Neither is an accurate model for organs, and both methods are tedious.



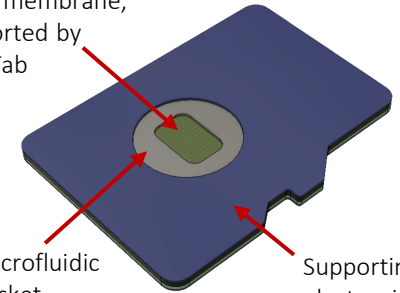
Typical costs are ~\$300 each



Organ-on-a-Chip devices create micro-environments for organs that can be controlled by researchers. Devices are expensive, limited in what can be done, and the tissues are difficult to access.

## XIDAS

Open membrane, supported by FlowTab



Microfluidic gasket

Supporting electronics

FlowTabs are disposable membrane systems with on-board supporting electronics for sensing and actuating. They insert into a reusable FlowTab manifold that drives microflow across the membranes. Size and shape is comparable to a micro SD card.

Xidas makes a small removable electronic FlowTab tissue culture system that allows a multitude of sophisticated membranes and configurations to be developed. Biologists work with tissues they want.



# Microfluidics System in Package. Electronics meets fluidics.

## Xidas smart microfluidic components

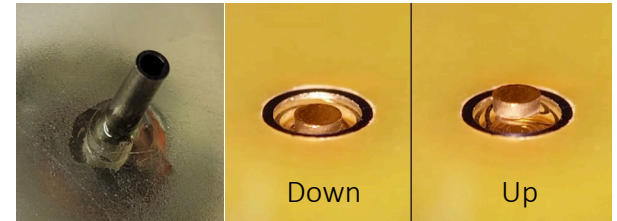
Xidas's smart microfluidic products are built using microelectronic manufacturing processes, allowing Xidas to leverage a massive technology base and manufacturing infrastructure.

Electromechanical valves/pumps are built on laminated substrates and leverage Xidas microactuator technology.

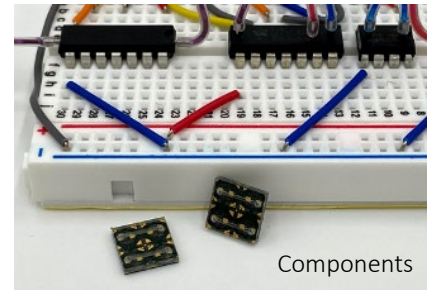
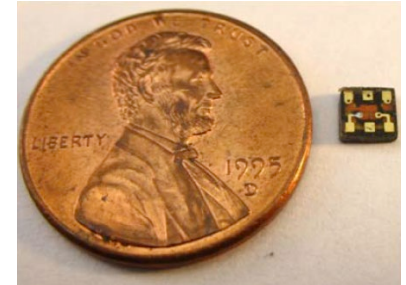
Inline temperature controllers include on-board temperature sensors for closed-loop control of temperature in microchannels.

Components can be provided in individual packages for assembly into larger systems. Alternatively, they can be integrated directly on to PCB microfluidics for advanced complexity (integrated microfluidic modules).

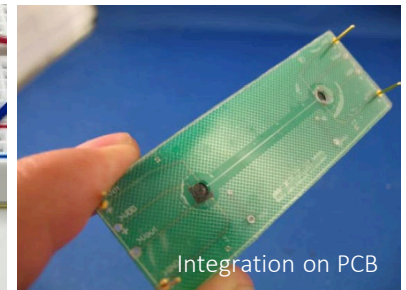
Actuating element of microfluidic valve (and pump)



Packaged temperature controller

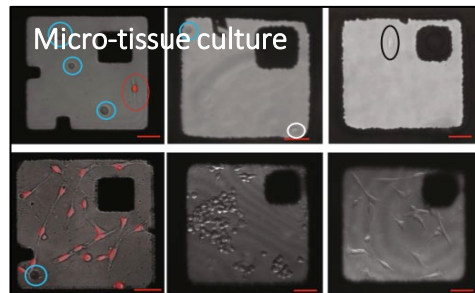
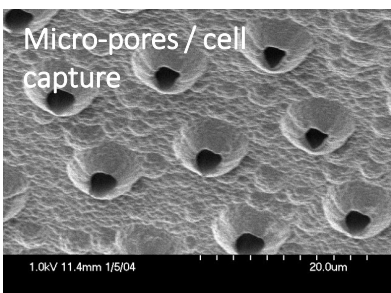
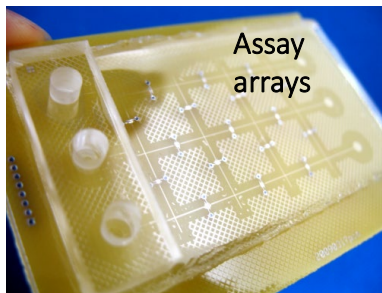
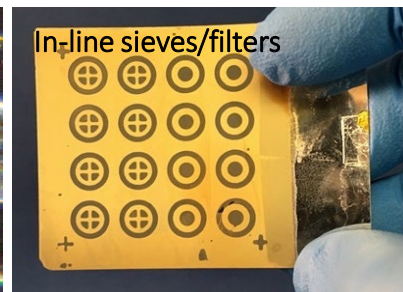
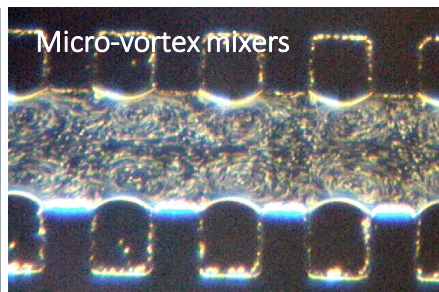
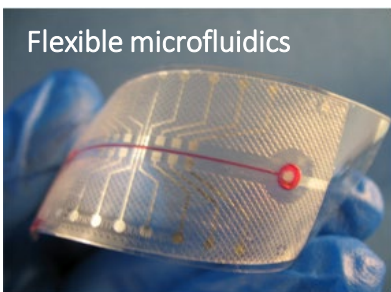
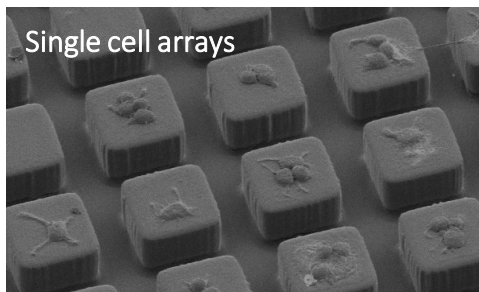
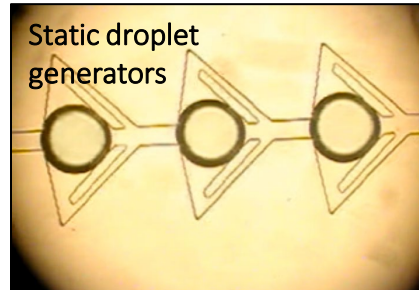
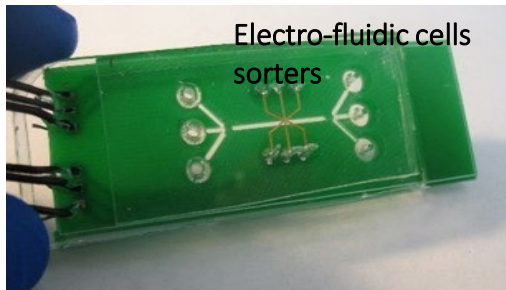
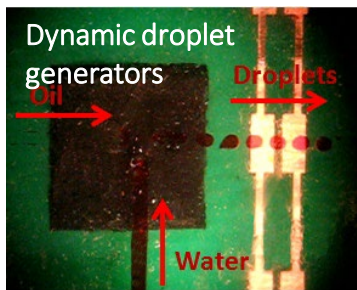


Components



Integration on PCB

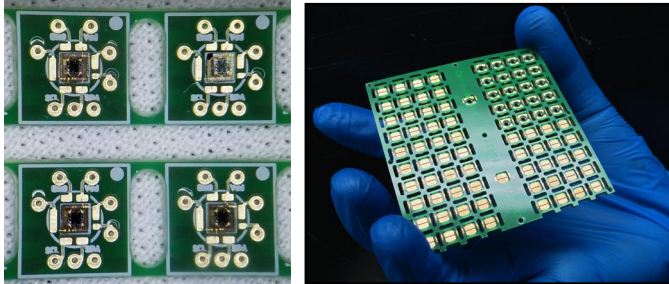
# Xidas can create many types of new microfluidic products.



# Xidas manufacturing capability

## Xidas in-house capability

- In-house R&D capabilities
- In-house design capabilities
- In-house test and measurement capabilities
- Prototype production (10's to 100's) in house
- Some materials/processes outsourced

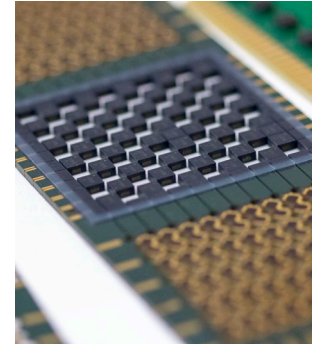


Example of prototype sensor units manufactured in-house

## Xidas volume capabilities

### Low/Medium volume production

- Contract manufacturing partners in US
- QC and final calibrations performed in-house

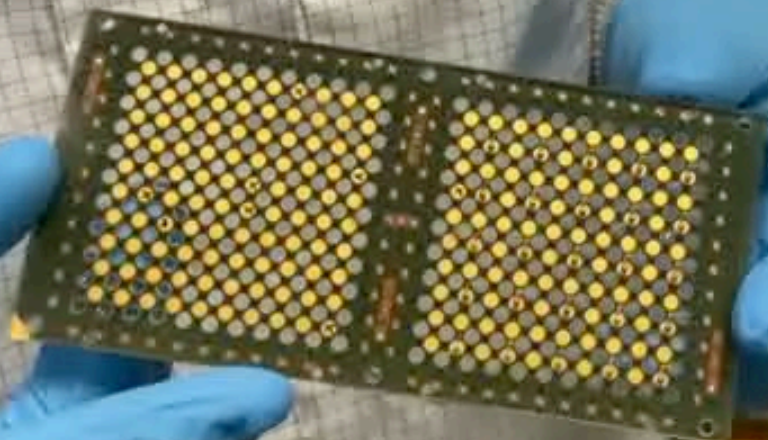


### High volume production

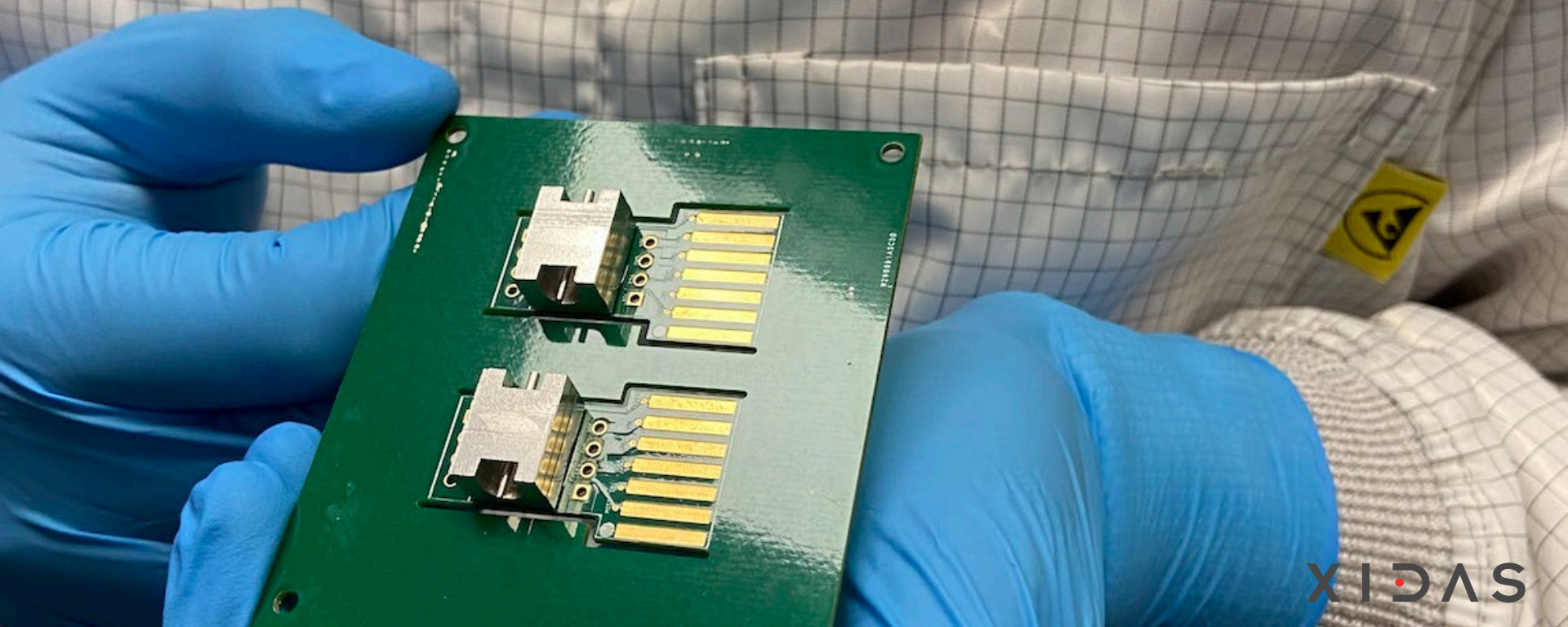
- Have relationship with large microelectronics packaging company: Carsem (Malaysia)
- Other microelectronics partners may be used



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# Let's collaborate!

*We are looking for strategic partners to help us grow our product portfolio and enter new markets.*

XIDAS