

ICAP

Israel Center for Advanced Photonics

Bringing edge to the Photonic industry

NL-IL Mini-symposium on Photonics
Apr. 22nd 2021

ICAP Vision

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Expanding the photonics boundaries for market applications, providing disruptive solutions

A Photonic Driver of the Hi-tech nation

ICAP Foundation

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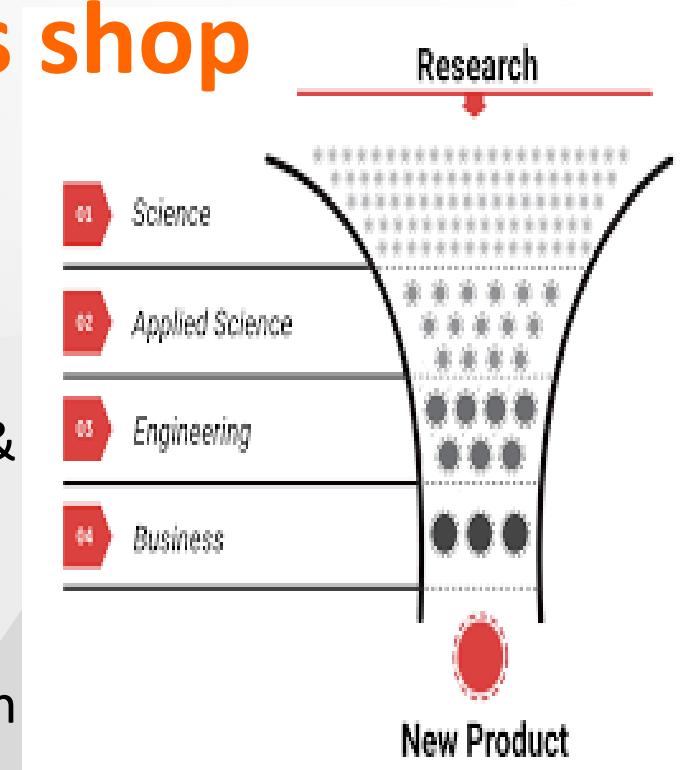
- Built by Israel Government as a Nation Fab-Lab for Photonics:
 - Investment: **65M\$**
 - Knowledge: Leading **National academic** in Soreq – In Physics, Photonics & related Materials
- Includes 3 Departments:
 - **Specialty Fibers** and Optical components Department – Research Foundry
 - **III-V Epitaxy growth** Department – Research Foundry
 - **BD and System solutions** Department for application grade solutions
- Direct access to Photonics Metrology and devices characterization labs, and top experts

ICAP edge and services - One stop applied photonics shop

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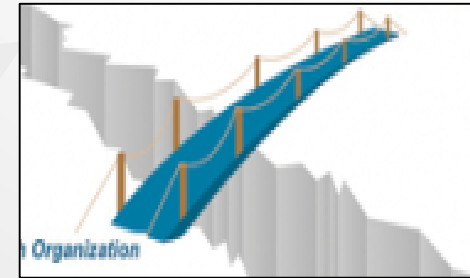
- **Research:** Over 100 PhD in physics, Photonics & related materials science
- **infrastructure:** The only **Photonic Epitaxy & fibers Fab-Lab** in Israel.
 - Support POC and small scale production.
- **Application level consulting and Execution**
Technology depth & Application driven
- **Collaboration culture:** Startup nation proximity for hybrid solutions: 2000 startup within 20km and many corporates, which we know most of them.



Goal: To be a disruptive **enable provider** for your application

Summary:

ICAP is a Bridge between Deep tech & applicable solutions



Corporates, Startups: Please bring your applicable challenges to
US

Entrepreneurs: We might be able to boost your next endeavor



Technology solutions highlights

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- Light receivers: sensors, PV
- Light sources: solid state Lasers, fiber lasers, LEDs, Microwave, etc.
- Photonics Components
- System level solutions for your applications (Mechanics, Hardware, Software, etc.)
- See more on our datasheet.

Photonics Total Available Market Enablers to vast known application

- Global Photonics market: 900B\$
- Global Photonic components market: 225B\$
- McKinsey report: 6 out of the 12 most disruptive field relates to Photonics

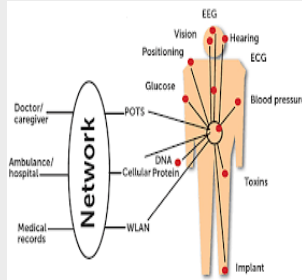
Data Centers:

Transceivers + Computing

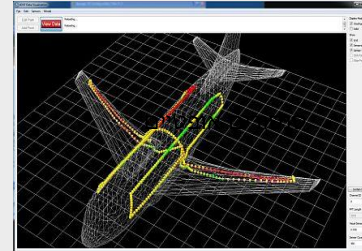


Medical:

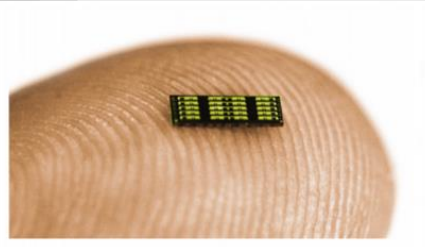
Sensing + Min. invasive Health/Comm.



Aviation:



HLS



Industry 4.0:
Foodtech, shipyard

Optical chips:
Sensors + Lasers

Lighting:
UV + Comm

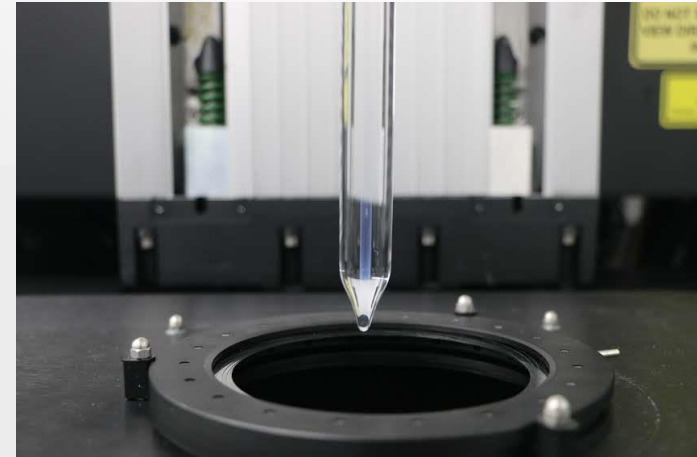
Clean-Tech:
PV/Water Q

Specialty Fibers and Optical components Department

Fiber Branch

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- MCVD and Chelate system for Preform manufacturing of specialty fibers (Including glass processing capabilities)
- Fiber Drawing Tower - 12.5 meter
- Preform & Fiber lasers Advanced Characterizations
- Fiber components – Design, Glass processing stations & Characterization
- Femtosecond Laser for FBG's inscription



Fabrication performances

| Optical Specifications | ICAP results | Required specs |
|--|------------------|------------------------|
| OH Level [dB/Km]@1383/4nm | 5.2 | <50 dB/km |
| Core Background loss [dB/Km]@1200nm | 0.5 | ≤ 1.5 dB/km |
| Clad loss [dB/Km]@1100nm | 5.38 | ≤ 15 dB/km |
| Core NA | 0.151 | 0.14 +/- 0.005 |
| Core Diameter [μm] | 17.37 | 15 +/-10% |
| Primary coating [μm] secondary coating [μm] | 162.23 252.37 | 166+/-10% 250+/-10% |

Epitaxy Growth Department

MOCVD (Metal-Organic Chemical Vapor Deposition)

Aixtron CCS Dual application system

- 2 growth modes:
 - **III-N** (e.g. GaN)
 - **III-V** (e.g. GaAs)
- **Substrates**
 - **6x2" / 3x3" / 1x4" / 1x6"**
- In-situ monitoring and controlling tools:
 - **EpiCurve TT** (temperature, thickness, curvature)
 - **Argus** (temperature mapping)
- Dynamic reactor height adjustments according to the growth parameters
- Max. temperature: 1300C (enables high quality **AlN** layers)



MOCVD Sources

- Metal Organics lines

TM**Ga**, TE**Ga**, TM**Al**, TM**In**, TM**Sb**, TB**As**, TB**P**

- Two NH_3 ammonia lines (**GaN**)

- Dopant lines

- n-type doping - **SiH₄**, **Si₂H₆**, **DETe**

- p-type doping – **DEZn**, **CpMg₂**

- Semi-insulating - **CBr₄**



| | 13 | III A | 14 | IV A | 15 | V A | |
|----|----------------------------------|----------------------------------|-------------------------------|--------------------------------|----------------------------------|--------------------------------|----------------------------------|
| | 5 | B 10.811 Boron | 6 | C 12.011 Carbon | 7 | N 14.007 Nitrogen | |
| 12 | Mg 24.305 Magnesium | Al 26.982 Aluminium | 14 | Si 28.086 Silicon | P 30.974 Phosphorus | | |
| 30 | Zn 65.39 Zinc | Ga 69.723 Gallium | | | As 74.992 Arsenic | | |
| | | 49 | In 114.82 Indium | | Sb 121.76 Antimony | 52 | Te 127.60 Tellurium |

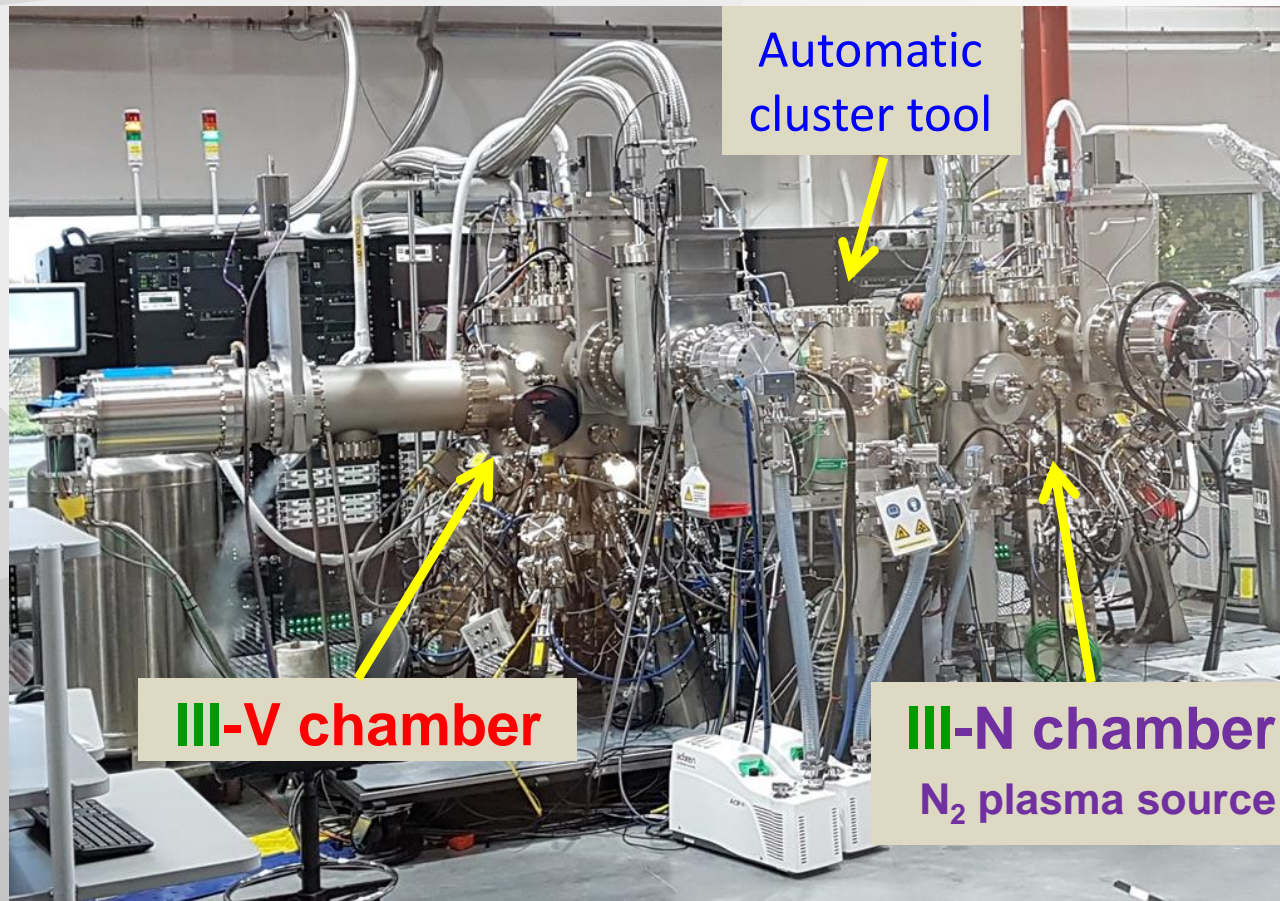
MBE (Molecular Beam Epitaxy)

Veeco GEN-20A **automatic double chamber MBE**

Substrates: **3x2"**, **1x3"** or **1x4"**

In situ monitoring tools:

- RHEED (surface)
- RGA (composition, impurities)
- BFM
- BandiT (temperature)



Automatic cluster tool

III-V chamber

III-N chamber
N₂ plasma source



Epitaxial layers characterization tools



HR-XRD mapping



Photoluminescence (PL)
mapping (0.3-2.6 μm)



CV profiler
(Doping profile)

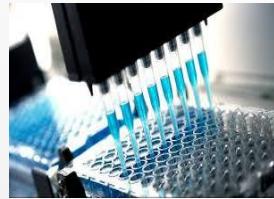
BD and System Branch Projects examples

Corona-Meter: Product specifications

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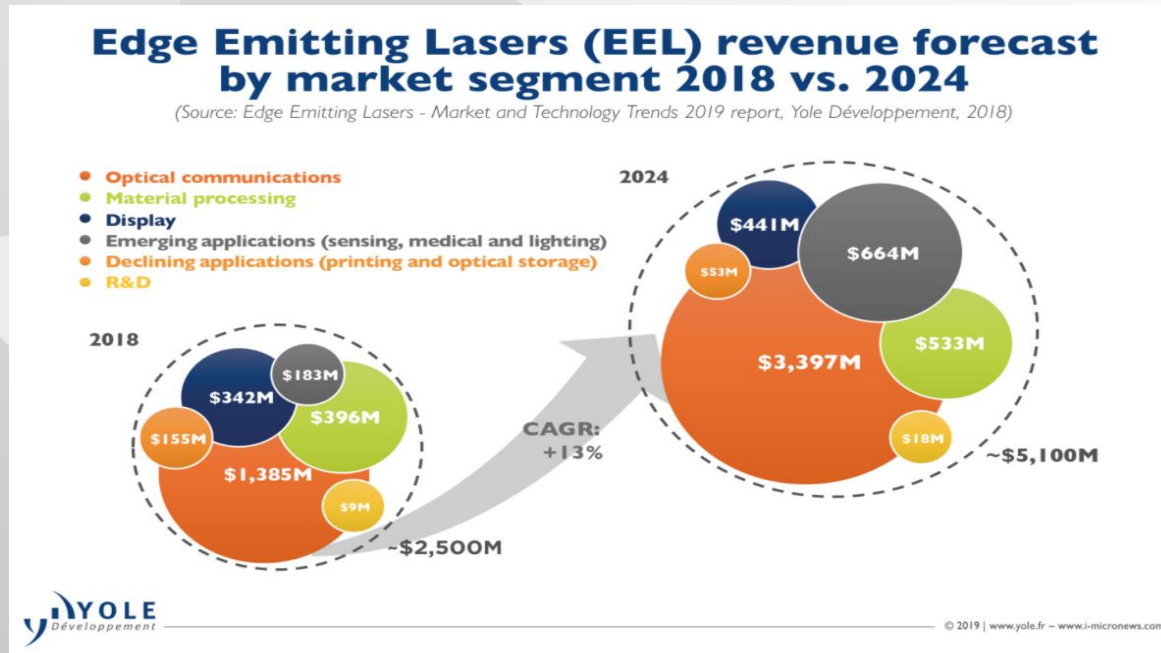
- Testing time: 1 minute result
- Test cost: Low cost
- Number of tests per day: 1000
- Human resource: Single operator
- Safety: High. Sample checked on spot and sterilized
- Mobility: High. Can be moved by car between locations



Magnet Opportunity:

Next Edge Emitting laser transition to VCSELs: 5B\$

Israel Magnet forecast: 2026: 0.5B\$, 2030: 1.5B\$



Challenge: Technical Gaps

High power: - Medical, Industrial, Lidar - 1.2B\$

Brightness/Baud rate: Communication - 3.4B\$

Beam quality/Profile: Sensing, (e.g timing) - 664M\$

http://www.yole.fr/iso_album/illus_eel_revenue_yole_may2019.jpg

ICAP - Summary

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Vision:

Expanding the photonics boundaries for market applications, providing disruptive solutions

Value-add:

Corporates, Startups: Please bring your applicable challenges to us

Entrepreneurs: Looking to boost your next endeavor, with our technologic accelerator

A Photonic Driver of the Hi-tech nation

Thanks for your attention

**Looking forward to hear your challenges and
collaborate
Feel free to E-mail/Text me:**

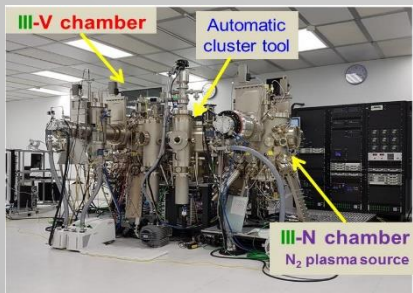


ICAP setup

Photonic edge



400 Researchers

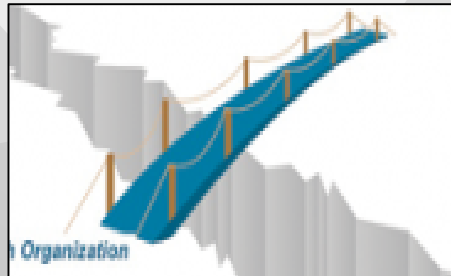


65M\$ FabLab

Industry facing



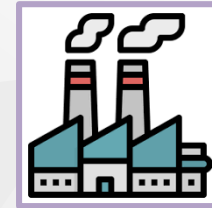
Business/Execution Oriented Management



Proactive TTO (P/L)

3 industry experienced PhDs

Proven services



Military

Small scale production

Corporates R&D

Startups

Internal Innovation

SME

ICAP Vision

The Israel Center for Advanced Photonics (ICAP) facilitates research and development in the fields of semiconductor technology and specialty optical fibers. The center constitutes a pivotal platform for the development of advanced technologies in these fields and of innovative sensors, coherent light sources and systems, based on the developed technologies.

With teams of highly qualified and experienced personnel, ICAP is in a position to offer very competitive research and development services to its customers, using some of the most advanced technology currently available.



Israel Center for Advanced Photonics

**Provides technology edge to the Photonic
based industries**



Israel Center for Advanced Photonics
המרכז הישראלי לפוטוניקה מתקדמת

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ICAP Capabilities

Semiconductor Technology

Epitaxial Growth

- ✓ III-V compounds: MOCVD and MBE
- ✓ III-N compounds: MOCVD and MBE
- ✓ Fabrication equipment



Semiconductors characterization

- ✓ Capacitance Voltage Profiler
- ✓ X-ray Diffraction
- ✓ Photoluminescence Analysis
- ✓ Microscopy

Specialty Optical Fiber Technology

Fibers

- ✓ Fiber design according to customer's specific requirements
- ✓ Active & passive preform fabrication
- ✓ Fiber drawing tower
- ✓ Fiber processing equipment
- ✓ Preforms and fibers test and measurement equipment
- ✓ Bragg gratings fabrication
- ✓ Fiber components



Innovation and system group

Provides complete end - to - end system and components solutions for system oriented customers

ICAP Fiber Branch Services

ICAP proposes a wide range of services for companies and academic institutes:

Fibers

Fiber customization and fabrication (FabLab):

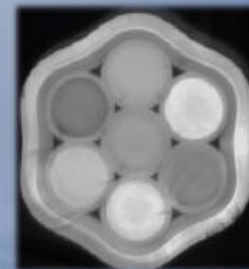
- ✓ Active Rare Earth (RE) doped fibers
- ✓ Large mode area fibers (SM/MM)
- ✓ Customize fibers to specifications



Fiber components/devices

Components design and fabrication:

- ✓ Fiber fused couplers
- ✓ Fiber combiners
- ✓ Fiber tapers
- ✓ End caps
- ✓ Fiber mode strippers
- ✓ Bragg grating inscription
- ✓ Fiber sensors
- ✓ Etc.



Cross section of a Fiber combiner

System

Complete infrastructure and expertise for custom development of coherent light sources and fiber optic based sensors.

System level integration group is available for higher level solutions. ICAP provides a "one-stop shop" solution to its customers.

Our Customers

ICAP collaborates closely with companies and academic institutions in Israel and around the world. We provide services to companies and various institutions, such as the following:

- ✓ Start-Ups
- ✓ Corporates
- ✓ Internal innovation
- ✓ Home Land Security (HLS)
- ✓ Academic and R&D centers



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