ISRAD

ROOTS OF TOMORROW

ICAP services and Products presentation

ICAP

INNOVATIVE PHOTONIC SOLUTIONS,
FOR YOUR APPLICATION

ISRAEL CENTER FOR ADVANCED PHOTONICS

THE ISRAELI CENTER **FOR ADVANCED PHOTONICS**

ISORAD/ICAP

The Israeli Center for Advanced Photonics.
The largest center of expertise in applied photonics in Israel.

Our customers get

IP based novel solutions tailored to meet their market requirements and providing them control over their supply chain at the components customization level

Our customers includes

- Leading Telecom corporate (Data centers)
- Point of Care diagnostic company (Medical)
- Leading Automotive suppliers, etc.
- Quantum Photonic customers

This presentation includes

our non-confidential material for you to explore and share:

- One Pager (Above)
- Technical Brochure that highlights our capabilities, technologies and infrastructure
- Products datasheets for Fibers, Light sources, FBG, Combiners and RE dopant-tester-analysis system, to buy off-the-shelf or ask us to customize per need

BUILDING CUTTING EDGE PHOTONIC BASED PRODUCTS **FOR OUR CUSTOMERS, FROM LAB TO FAB**

III-V semiconductors: Leading Industry 4.0 customer

- (GaAs, InP, InSb, GaN, …)
- MOCVD & MBE epitaxial growth
- Photonic devices design and fabrication

Specialty Fibers and Fibers components: Leading High Power lasers customer

- Specialty Optical Fiber Technology
- Fiber components/devices
- Custom Design, Fabrication and Characterization

Photonic innovative technologies: Leading Datacom and Medical customers

- Fibers coupling (splicing to chips, crystals)
- Femtosecond laser Inscription (FBGs, splitters, waveguides)
- Custom optical solutions

The Israel Center for Advanced Photonics is a division of ISORAD Ltd.

ISORAD: A bridge to Industrial Solutions for SOREQ research center

Well-equipped research , engineering & custom production facility

Well experienced multi disciplinary researchers and engineering teams (Photonics, Optics, System Engineering, etc.)

Israel Center for Advanced Photonics
המרכז הישראלי לפוטוניקה מתקדמת

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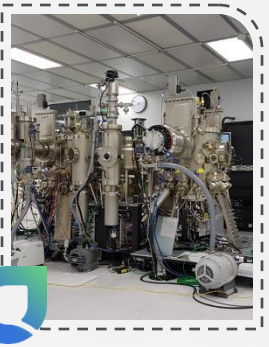
BROCHURE

ICAP Capabilities

Semiconductor Technology

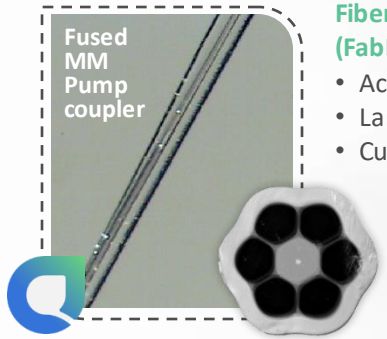


Epitaxial Growth
- III-V compounds (GaAs, InP, GaSb, InAs, etc.): **MOCVD** and **MBE**
- III-N compounds (GaN, InGaN, AlGaN…): **MOCVD** and **MBE**

Epi-layer Characterization
- X-ray Diffraction
- Photoluminescence Analysis
- Capacitance Voltage Profiler
- Microscopy

Semiconductor components fabrication
- Advanced light sources (VCSELS, Edge-emitting Laser diodes, QCL)

ICAP Fiber Branch Services



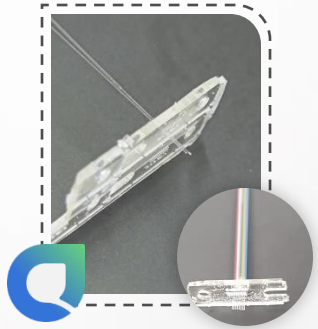
Fiber customization and fabrication (FabLab):
- Active Rare Earth (RE) doped fibers
- Large mode area fibers (SM/MM)
- Customize fibers to specifications

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.

Specialty Optical Fiber Technology

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

Innovation and system group



Group capabilities

Femtosecond laser writing:
- Direct laser inscription of waveguides in glasses and crystals
- 1D/2D/3D architectures (waveguides, splitters, etc.)
- Fiber Bragg gratings (FBGs)
- Inscription through phase mask
- Through-the-coating inscription

Fibers coupling:
- Fusion splicing of fibers to chips/crystals
- Custom sub-micron mechanical structures for accurate passive alignment

Custom photonic systems and integrated multi-disciplinary solutions.

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. From proof-of-concept - to prototype validation and to manufacturing scale up.


Light guided in a splitter

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

PRODUCTS AND REFERENCE DESIGNS // # ICAP Specialty FIBERS Portfolio

ICAP FIBERS

Undoped fibers

1|	**Hi -1060**	Compatible SCOF for SM signals delivery at 1µm
2|	**15/130 0.08/0.46**	Passive matched DCOF for 1µm Medium power fiber laser.
3|	**20/400 0.06/0.46**	Passive matched DCOF for 1µm high power fiber laser
4|	**25/250 0.06/0.46**	Passive LMA DCOF for 1µm high power fiber laser
5|	**9/125 0.14/0.46**	Passive SM for Radiation Sensing

Yb Doped fibers

6|	Yb 15/130 0.08/0.46	Ytterbium doped DCOF for medium power fiber laser
7|	Yb 20/400 0.065/0.46	Ytterbium doped DCOF for 1µm high power fiber laser
8|	Yb 6/125 0.15/0.46	Ytterbium Highly doped for medium power fiber laser

PM fiber

9| 10/125 0.075/0.46 Passive PM DCOF

10| 20/400 0.065/0.46 Passive PM DCOF

NOTE Fibers can be customized to user requirements

NOTE Each Fiber type above can be produced as PM or Non- PM

PRODUCTS AND REFERENCE DESIGNS // # ICAP Specialty FIBERS Specifications

YDCOF-20/400 0.06/0.46NA

Ytterbium doped Double Clad fiber for high

Fiber specification	
Optical Specifications	
Optical Specifications	
Operating Wavelength	1015 – 1115 nm
Core NA	0.065 ± 0.005
First Cladding NA(5%)	≥ 0.46
Core Attenuation	≤ 20 dB/km @ 1200 nm
Cladding Attenuation	≤ 15 dB/km @ 1100 nm
Cladding Absorption (dB/m)	0.4 ± 0.05 dB/m @ 915nm
Geometrical Specifications	
Cladding Diameter (octagonal flat to flat)	400 ± 10 µm
Core Diameter	20 ± 1.5 µm
Coating Diameter	550 ± 15.0 µm
Coating Concentricity	< 7.5 µm
Core/Clad Offset	≤ 2 µm
Coating Material	UV Cured, Dual Acrylate, Fluoro-Acrylate primary layer
Mechanical Specifications	
Proof test Level	≥ 100 kpsi (0.7 GN/m²)

PMDCOF-20/400

Passive Polarization Maintaining DCOF

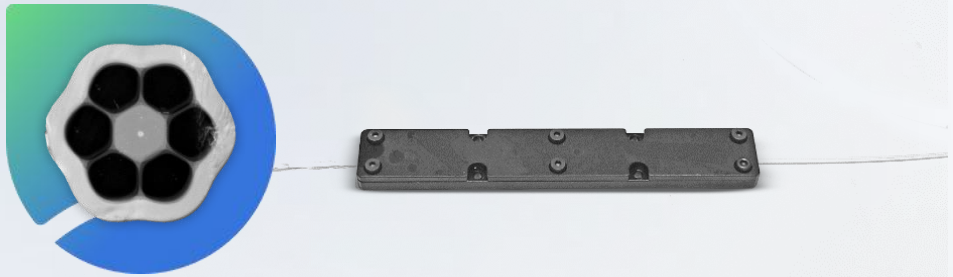
Fiber Specification	
Optical Specifications	
Operating Wavelength	1015 – 1600 nm
Core NA	0.065 ±0.005
First Cladding NA(5%)	≥ 0.46
Core Attenuation	≤ 5 dB/km @ 1060 nm
Cladding Attenuation	≤20 dB/km @ 1100 nm
Birefrinegence	≥ $4 \cdot 10^{-4}$
Geometrical Specifications	
Cladding Diameter (round)	395 ± 10 µm
Core Diameter	20 ± 1.5 µm
Coating Diameter	550 ± 15.0 µm
Coating Concentricity	< 7.5 µm
Core/Clad Offset	≤ 2 µm
Cladding non-circularity	≤ 1%
Coating Material	UV Cured, Dual Acrylate, Fluoro-Acrylate primary layer
Mechanical Specifications	
Proof test Level	≥ 100 kpsi (0.7 GN/m²)

PRODUCTS AND REFERENCE DESIGNS //

HIGH POWER COMBINERS

High power (6+1)x1 pump – signal combiner

(6+1)×1 fiber combiner is used for high power fiber lasers. It combines six fiber coupled pump diode laser modules and one signal channel into one double clad fiber. All Fiber types can be customized to user requirements.



Device Characteristics			
Configuration	**Port Numbers**	**Fiber Type**	**Remarks**
Pump port input	6 ports	200/220 µm 0.22NA	Other fiber types possible
Signal input port	1 port	10/125 µm 0.08NA	Other fiber types possible
Output port	1 port	20/400 µm 0.08NA	Other fiber types possible

Optical performance			
Parameter	**Value**	**Units**	**Remarks**
Operating Wavelength (signal)	1040-1080	nm	Other wavelengths possible
Operating Wavelength (pump)	800-1000	nm	Other wavelengths possible
Maximum insertion loss (signal)	0.5	dB	
Maximum insertion loss (pump)	0.1	dB	
Pump handling power (each pump leg)	400	Watt	
Signal power	20	Watt	Typical value
Output signal beam quality (M^2)	<1.3		
Pump return loss	>40	dB	
Maximum return pump power	10	Watt	

Mechanical specifications			
Parameter	**Value**	**Units**	**Remarks**
Dimensions (LxWxH)	100x15x6	mm	
Fiber pigtail	1-1.5	m	Other lengths possible

PRODUCTS AND REFERENCE DESIGNS //

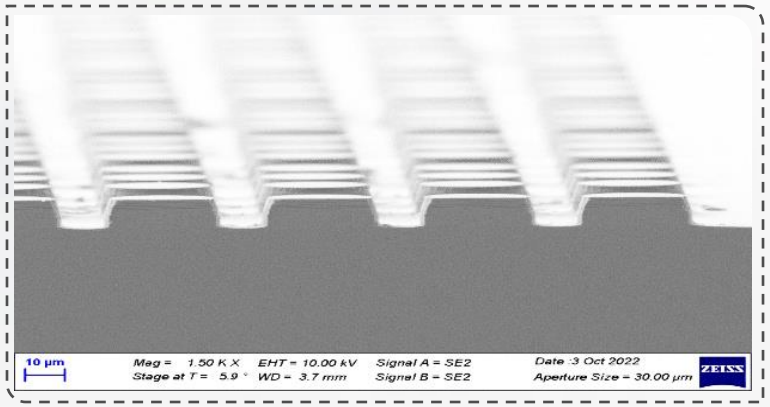
VCSELS

Solid state Light sources:

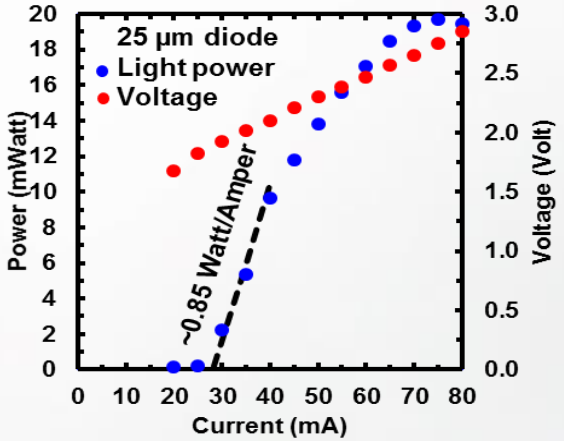
VCSELs, EELs

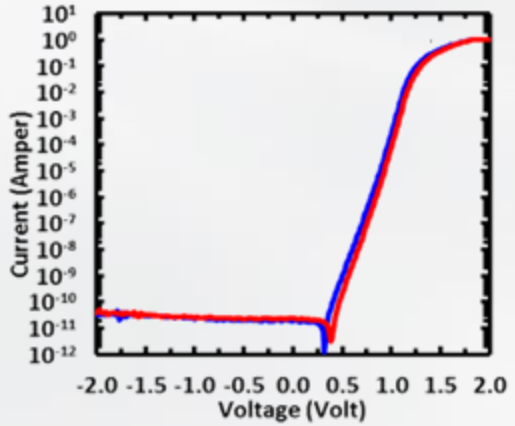
Services types:

- EPI wafers only
  MOCVD and MBE Epitaxial growth is possible
- EPI + Fabrication



Device Characteristics	
Parameter	**Value**
Operating Wavelength	9XX (600-1000 possible)
Slope efficiency	0.8 W/A
Turn-on Voltage	~1.2V

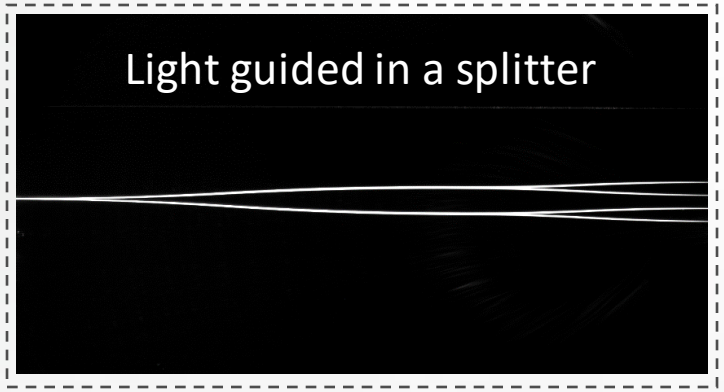




PRODUCTS AND REFERENCE DESIGNS //

WAVEGUIDES INSCRIPTION AND FIBER TO CHIP CONNECTION

Description:
Inscription of buried waveguides within transparent materials such as fused silica and electro-optical crystals, featuring both 2D and 3D configurations. Our designs are tailored to meet the specific requirements of our customers. The inscription process is carried out using a femtosecond laser, modifying material properties at the focal point.
Fibers can be securely attached through gluing or fusion splicing.



Material	Fused silica, transparent crystals
Substrate dimensions	Width:5-50mm , length: 5-50mm (can be customized)
Waveguides types	Straight, splitters, 3D structures
Waveguide depth	<150um (more upon request)
Fabrication method	Femtosecond laser inscription
Type	Single mode/multi mode
Fiber coupling (optional)	Fusion splicing/gluing
Characterizations (optional)	Losses

PRODUCTS AND REFERENCE DESIGNS //

FBG

Fiber Bragg Grating – Datasheet

Description:

A Fiber Bragg Grating (FBG) is an optical reflector that is used for many applications, from temperature and strain sensing to fiber lasers mirrors. FBGs array can also function as an array of sensors inscribed along a single fiber (distributed sensing).

At the **Israeli Center for Advanced Photonics (ICAP) inscribes FBGs using Ti:Sapphire** femtosecond laser and Phase-mask (PM) technique. Central wavelength and bandwidth of the reflected signal can be adjusted to customer's specifications. ICAP can supply FBGs in standard single-mode (SM) fiber or specialty fibers upon request. Inscription techniques may involve the removal and reinstatement of the fiber's coating, Inscription through the coating is optional as well.

Specifications:

Parameter	Value
Central wavelength (nm)	1050 – 1080 1540 – 1570 Other on request
Reflectivity	1% -99.99%
Wavelength tolerance (nm)	±0.5
Bandwidth FWHM (nm)	0.5-1
FBG length (mm)	≤10
chirp	On request
FBGs Array	Optional
Fiber type Cladding diameter (µm)	SM, MM 125; other on request
Coating type Coating diameter (µm)	Acrylate; Polyimide
Fiber core composition	Germanium doped Pure silica Other on request

Website: www.icap.org.il E-Mail: info@icap.org.il

PRODUCTS AND REFERENCE DESIGNS // RE Tester

Non-destructive characterization of Rare Earth (RE) concentration and distribution in the core of active fiber preforms

Description:

In Rare Earth (RE) doped optical fibers used for fiber lasers, accurate control and characterization of the refractive-index profile (RIP) and the active dopant profile (ADP) are crucial for the fiber laser performance, in terms of efficiency and overall performance. Although there are methods for monitoring the RE concentration in the fiber's preform, these methods are destructive. In particular, measurements of the Yb concentration and its transverse and longitudinal distribution along and across the preform are carried out by slicing the preform into thin discs and inspecting the Yb concentration and its distribution in the disks by electron probe microanalysis methods e.g. EPMA. Albeit these methods provid an accurate assessment of the RE dopant concentration, it renders the preform usless due to its destruction by slicing.

ICAP developed and currently produces a system that allows for measuring the RE concentration and distribution in active preforms, by translating the emission pattern and the spontaneous emission lifetime of the preform's core (prior to its drawing) into the ADP. Main benefit of this method is accurate three dimensional ADP profiling (across and along the preform), as well as higher preform yield, by eliminating the need to corrupt the measured preform.

By accurately moving the preform up and down, as well as rotating it, the RE dopant concentration and cross sectional distribution is measured at various locations along the preform and at various angles.

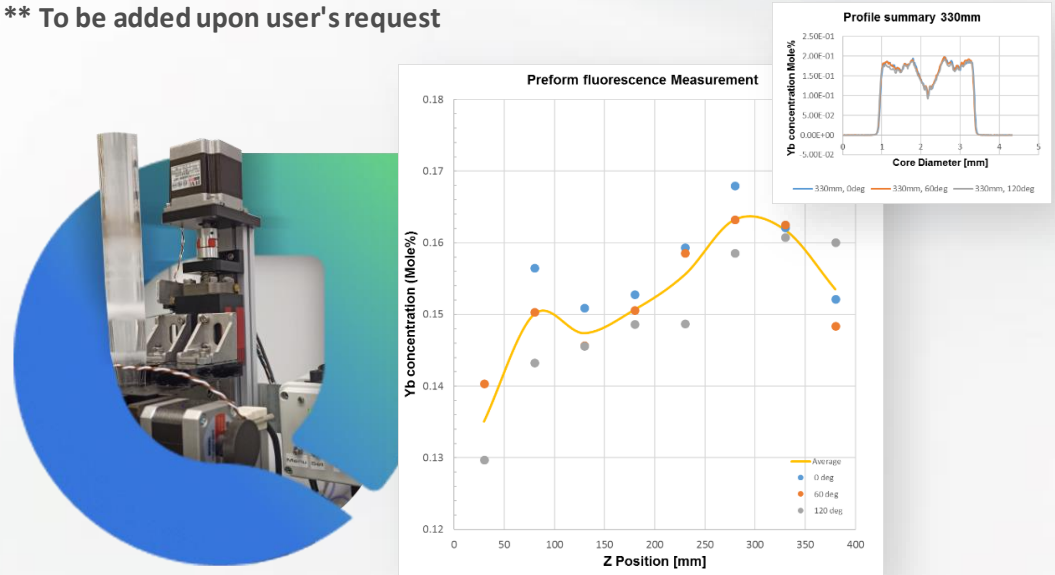
This system allows for a fast and accurate measurement of the Preform's ADP prior to its drawing into an active fiber, for the benefit of improving the performance of future active fibers without needless destruction of expensive preforms.

Key Features

- Rapid and accurate measurement of RE dopants profile and concentration of active fiber preforms.*
- Nondestructive 3D profiling utilizing optical fluorescence measurements.
- Possible photo darkening decay measurement in preform level**
- Custom system configurations available upon customers request.

*** Yb at present. Will be expanded to other RE dopants in the near future upon customer's request**

**** To be added upon user's request**



ISORAD/ICAP IS A BRIDGE BETWEEN DEEP TECH **& APPLICABLE PHOTONIC SOLUTIONS**

How can we **help you Invent?**

Corporates, Startups

- Better Control of your supply chain
- Assistance in Overcoming Technical barriers

Entrepreneurs

Boost your next endeavor

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ABOUT **US**

The Israeli Center for Advanced Photonics commenced its project-driven operations in 2019, specializing in applied research and development across diverse photonics fields. Our expertise lies in providing cutting-edge photonics solutions, tailored specifically for companies seeking innovative advancements.

Since our establishment, we've successfully completed approximately 15 research and development contracts for a wide spectrum of Israeli companies, ranging from startups to corporate entities, spanning various industries. Our comprehensive range of services covers the entire developmental spectrum: from initial problem definition and brainstorming, research to prototyping. ISORAD/ ICAP supports the entire journey from laboratory testing to large-scale fabrication, offering in-house high-scale production of fibers, as well as small-scale production of photonic connectivity solutions and Phtonic chips. Additionally, our center integrates engineering services seamlessly.

Having solidified our presence in the Israeli market, we are now poised to extend our services to international clients. Our expertise caters to numerous sectors, including data centers, medical technology, aircraft construction, homeland security, industry 4.0, optical chips, light sources, light sensors, cleantech, agriculture, optical computing, and more

As an illustration of our technological prowess, the center's researchers pioneered a diagnostic optical chip for a specialized 'Point of Care' diagnostics company. ISORAD/ICAP delivered a solution that is not only more cost-effective but also boasts enhanced robustness, flexibility, and a compact footprint. This collaboration further fortified the company's intellectual property rights associated with the chip.

Presently, we are advancing into the Design for Manufacturing (DFM) phase, concurrently devising a small-scale production facility tailored for these customized chips.

Essentially, our center remains steadfast in pushing the boundaries of photonics through groundbreaking research while providing industrial-grade services in development

THANKS

FOR YOUR INTEREST IN ISORAD/ICAP

Products and Reference Designs

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