Fiber Lasers
FOR MICROPROCESSING

FLEXIBILITY • PRECISION • QUALITY

IPG PHOTONICS®

THE IPG
Difference

PIONEER & INDUSTRIAL FIBER LASER LEADER

IPG invented and popularized industrial fiber lasers revolutionizing materials processing across virtually every industry and application. Our dedication for continuous innovation now brings world leading fiber laser technologies into advanced microprocessing solution that deliver exceptional performance and cost advantages combined with industrial utility and robustness.

VERTICALLY INTEGRATED R&D AND PRODUCTION

We design, produce and rigorously test all of the critical components in every IPG laser. Vertical integration speeds up product development, allowing us to meet the needs of customers faster than any other company. Internal production of all critical components and in-house quality control ensures delivery of the highest quality products at the lowest costs for our customers.

WIDEST RANGE OF PRODUCTS

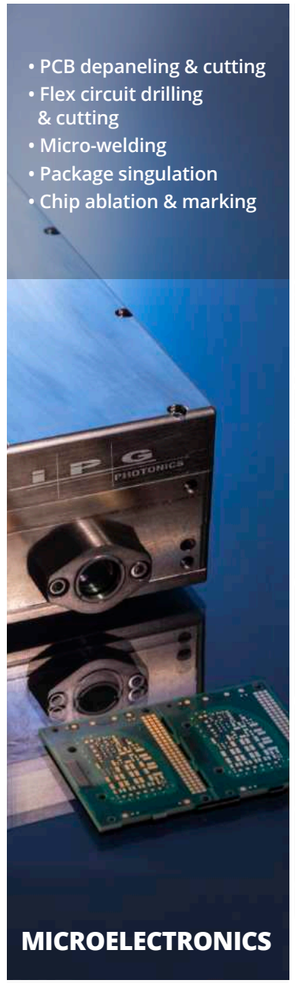
IPG offers the most diverse range of laser sources for microprocessing across all modes of operation from continuous wave to pulsed nanosecond and ultrafast, the broadest wavelength range from ultraviolet to green to mid-infrared, and the widest power range from watts to kilowatts. Our integrated microprocessing products include scanning heads for cutting, drilling, welding, cleaning and surface modification, plus real-time process monitoring, and complete laser systems.

Fiber lasers provide microprocessing capabilities for high quality low-cost production of the most complex devices. Without fiber lasers, these devices would be either too costly for mass adoption or simply impossible to produce.

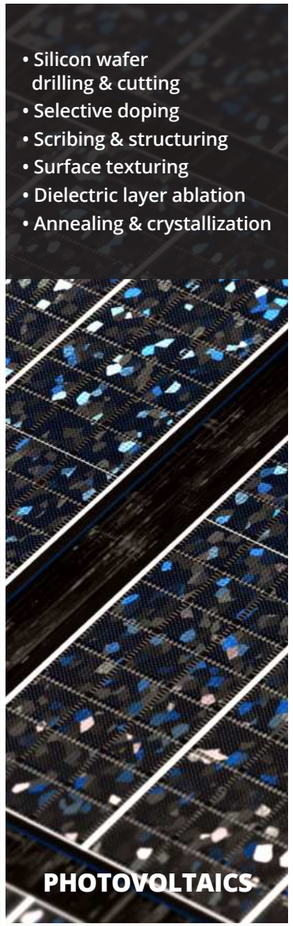
MICROPROCESSING SOLUTIONS

for any Industry, Material and Application

Products across all industries continue to get smaller and more complex. **Precision, speed** and **quality** are the key factors in microprocessing of components commonly found in our daily lives. Cutting of transparent and brittle materials, joining plastics, selective material removal, micro-drilling and surface structuring are all applications that benefit from our wide range of fiber laser microprocessing solutions.



New consumer devices continue to provide **more functionality while shrinking in size**, requiring manufacturers to produce even smaller components with higher density connections.



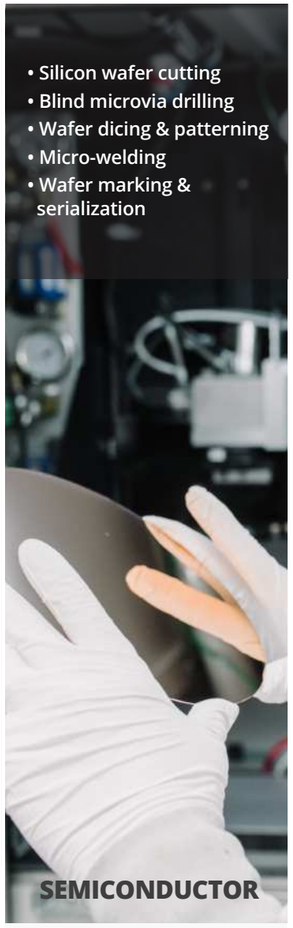
Since 2010, solar has experienced an average annual growth rate of ~50% due in part to a 70% decrease in installation costs. Manufacturers rely on **the high accuracy** and **flexibility of fiber lasers** to meet this demand.

In the U.S. alone, nearly 2 million stents are implanted annually. Fiber lasers provide the **high-precision**, **repeatability** and **minimal thermal input** for cutting these tiny devices.

Modern vehicles widely utilize innovative and lightweight polymer materials. Joining and modifying components with simple and complex geometries is made possible with the **flexible, reliable** and **consistent processing** provided by fiber lasers.

Aerospace vehicles are complex and comprised of thousands of complex components. From minute sensor production to high-speed drilling of massive turbines, fiber lasers **improve production and increase quality.**

Displays continue to evolve towards thinner, lighter, brighter and more ergonomic designs. Fiber lasers **overcome manufacturing challenges** for displays with minute features and **differing material combinations**.



Increasing transistor densities of < 3 nanometers has prompted foundries and fabs to embrace the **high-accuracy** and **precision** of fiber lasers to enable die size reduction and further miniaturization of devices.

Global electric vehicle sales continue to rise annually. Only fiber laser technology can help manufacturers **decrease costs** of electric vehicles to drive their mass adoption.

ADVANTAGES OF FIBER LASERS for Microprocessing

IPG world leading fiber laser technologies produce the most advanced, most productive and flexible range of lasers for microprocessing applications

ULTRA-COMPACT
IPG ultrafast fiber lasers combine CPA architecture with our revolutionary technologies to create the most compact ultra-short pulsed lasers in the world - incredible compactness with massive capability.

EASY INTEGRATION
Compact rack and module formats plus flexible fiber delivery and ultra-compact heads enable easy integration and integration in locations with limited space.

FLEXIBLE ARCHITECTURE
Laser sources offer a broad range of output powers, pulse energies, repetition rates and wavelengths to best match microprocessing applications.

Unmatched benefits for unlimited applications

LOW MAINTENANCE
IPG fiber lasers are designed to require virtually no maintenance. Increased uptime for more microprocessing throughput and lower cost per part.

RELIABILITY
IPG fiber lasers are the most reliable in the industry. Our unique internal designs provide redundancy and consistent power that will not degrade over time.

ENERGY EFFICIENT
IPG laser diodes are the most efficient in the world. Less power consumed reduces overall operating costs.

NO WARM-UP
IPG fiber lasers are ready to go when you are. Less time waiting and more time microprocessing.

FLEXIBLE FIBER DELIVERY
IPG fiber cables provide long runs for maximum integration in locations with limited space.

ULTRAFAST
PULSED LASERS

Ultrafast fiber lasers operate in the range of picoseconds (10^{-12} seconds) and femtoseconds (10^{-15} seconds). **Balanced throughput, precision** and **quality** are made possible with the shorter pulse durations of ultrafast lasers without undesirable heat affects. This cold processing virtually eliminates heat affected zones, unwanted melting and cracking for consistent, controlled processing of the most sensitive materials.

THE MOST **COMPACT** ULTRA-SHORT LASERS IN THE WORLD

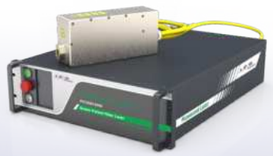
Flexible Integration

High Peak Power

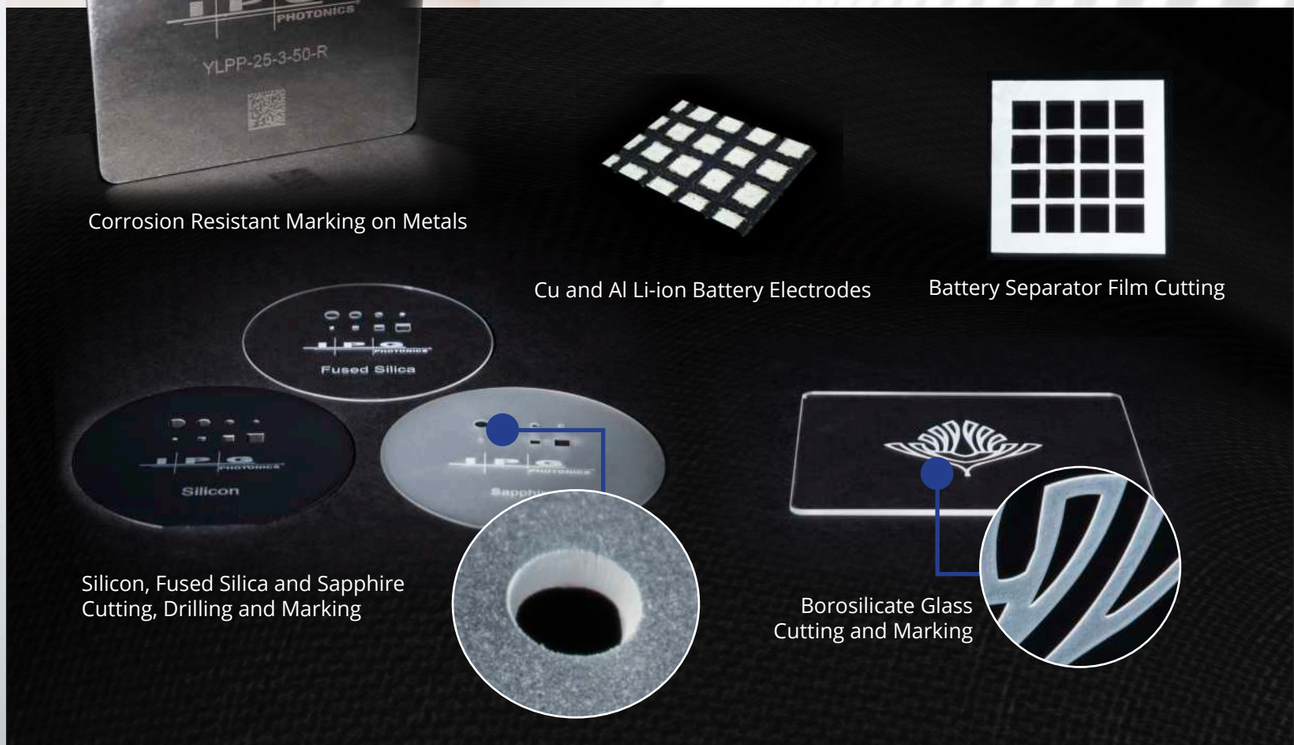
Exceptional Performance

CONFIGURATION OPTIONS:

UP TO 200 µJ PULSE ENERGY
250 fs - 5 ps PULSE DURATION
UP TO 200 W OUTPUT POWER

		
INFRARED	**GREEN**	**ULTRAVIOLET**
1 µm	515 nm	343 nm

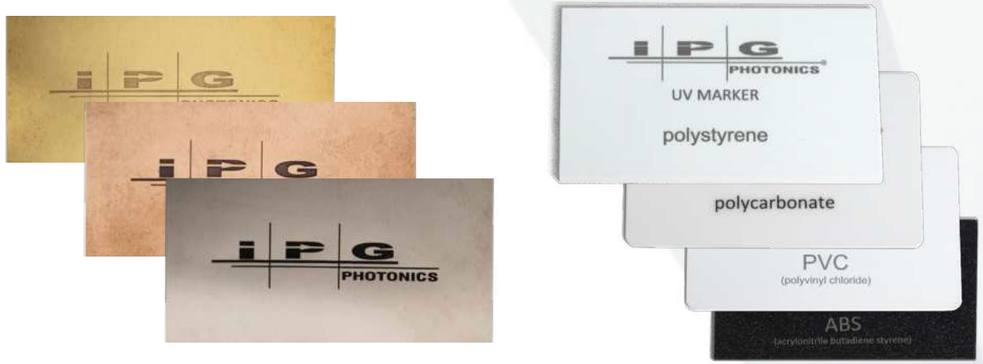
Medical Stent and Fine Tube Cutting



NANOSECOND
PULSED LASERS

Nanosecond fiber lasers produce short pulses (10^{-9} seconds) with **small focal spots** and **high energy** for **precision microprocessing**. This combination enables high-speed ablation, surface texturing, marking and cutting of typically challenging thin, flexible and reflective materials for nearly every industry. These lasers are available in various wavelengths from infrared to green to ultraviolet with high pulse energy for optimized processing of specific materials, and offer high repetition rates for high-speed applications and single mode output for maximum precision.

WIDEST RANGE OF MATERIALS PROCESSING

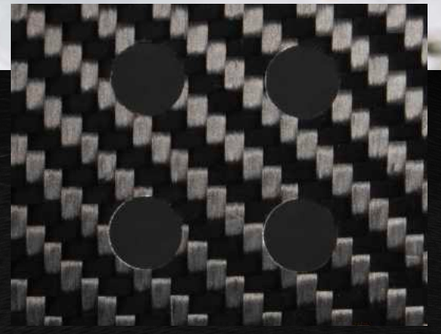


1 ns - 1 ms FIXED & ADJUSTABLE PULSE DURATION OPTIONS
ADJUSTABLE PULSE WAVEFORMS & TEMPORAL SHAPING

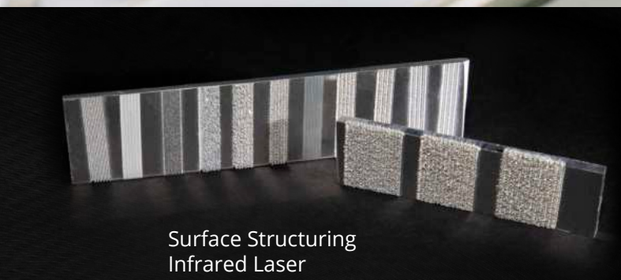
	INFRARED	GREEN	ULTRAVIOLET
	~1 µm	515 - 532 nm	355 nm
Pulse Energy options	up to 150 mJ	up to 1 mJ	up to 30 µJ
Output Power options	up to 3 kW	up to 200 W	up to 10 W

OPTIONAL BURST MODE CAPABILITY

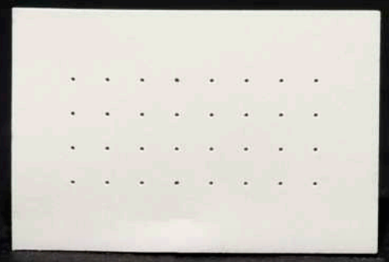
Polyimide Cutting
Ultraviolet Laser



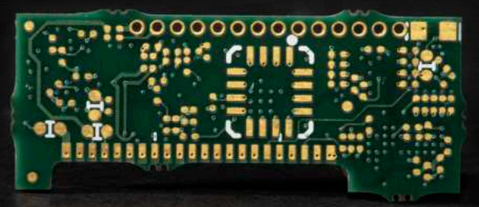
Carbon Fiber Polymer Cutting and Drilling
Green Laser



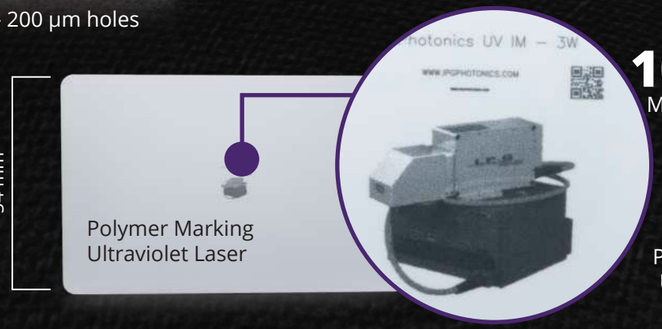
Surface Structuring
Infrared Laser



Ceramic Drilling - 200 µm holes
Green Laser



PCB Cutting
Infrared / Green Laser



CONTINUOUS & QUASI-CONTINUOUS LASERS

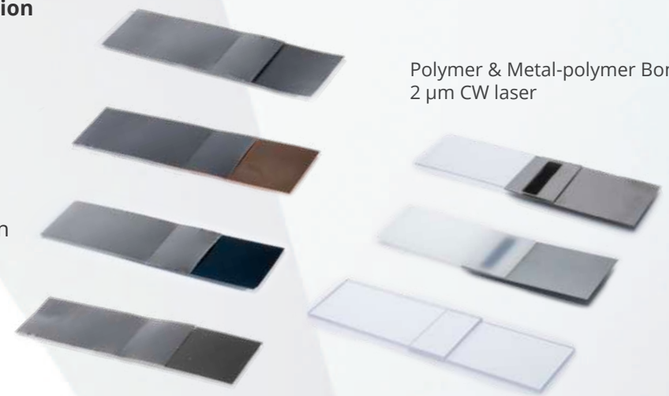
Continuous wave (CW) fiber lasers emit light continuously with controlled power output, whereas quasi-continuous wave (QCW) fiber lasers emit light in long pulses. Both methods produce **high-quality microprocessing** results for numerous applications and material combinations. These lasers offer single-mode output to deliver the smallest beam profile for **maximum precision**, high peak power options for clean cutting of fine features, and fixed or tunable wavelengths to best match advanced applications.

METAL TO POLYMER JOINING **MADE EASY**

2 µm fiber lasers provide the high absorption needed for cutting, welding and marking polymers

Compared with lasers at lower wavelengths, 2 µm fiber lasers:

- Enable volumetric absorption for clear lower layer joining
- Impart no material coloration or modification
- Utilize relaxed clamping
- Join at high-speeds > 1 m/s
- Offer remote processing with long focal lengths



Polymer & Metal-polymer Bonding
2 µm CW laser

HIGH PEAK POWER

YTTERBIUM CW

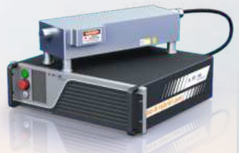
0.975 - 1.075 µm
Single-mode up to 2 kW
Air-cooled up to 700 W

YTTERBIUM QCW

1.07 µm
Pulse Energy up to 60 J
Repetition Rate up to 50 kHz

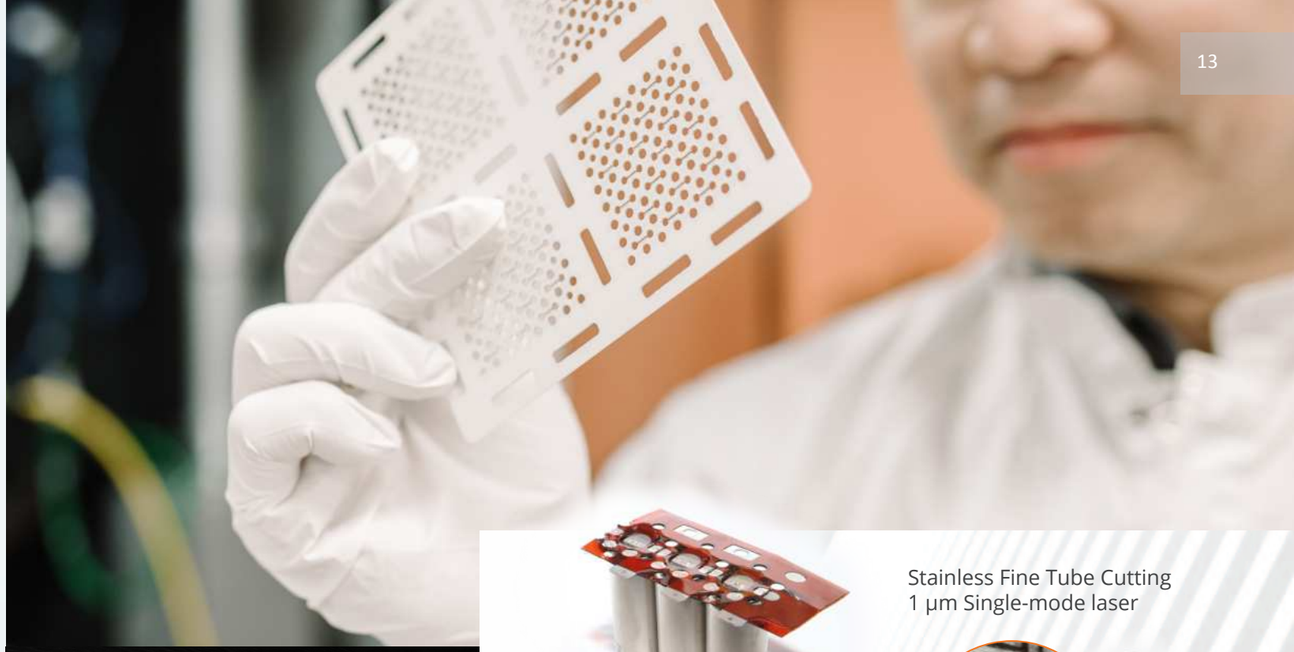
THULIUM CW

1.9 - 2.05 µm
up to 200 W
Repetition Rate up to 1 kHz



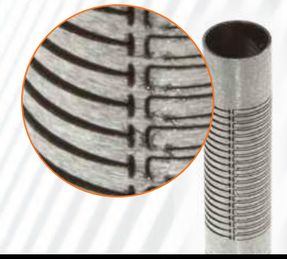
MID-IR HYBRID CW

1.9 - 3.2 µm
up to100 W
Fixed or tunable wavelengths

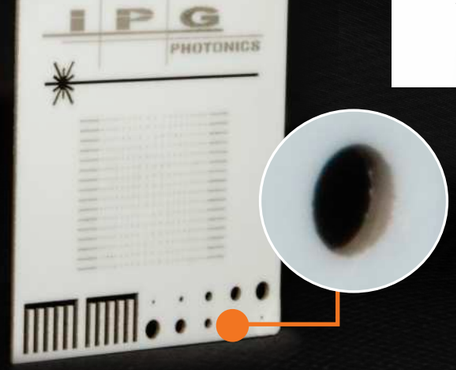


Battery to Busbar Welding
1 µm Single-mode laser

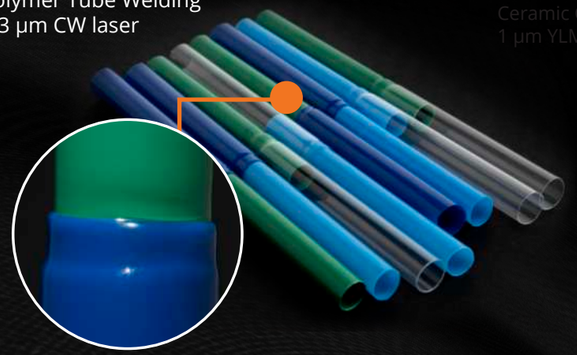
Stainless Fine Tube Cutting
1 µm Single-mode laser



Ceramic Cutting and Drilling
1 µm QCW Single-mode laser



Polymer Tube Welding
2.3 µm CW laser



Ceramic Cutting
1 µm YLM-QCW

Sapphire and Silicon Cutting
1 µm QCW Single-mode laser

INTEGRATED Scanners

Complete laser source and scan head modules enable easy integration in compact and cost effective packages. High-speed, high-precision scanning increases microprocessing throughput without sacrificing quality. Modules are pre-calibrated and include control electronics and software to minimize set up time and ensure high-quality results.

- Complete Modules for Integrators & OEMs
- Variety of Scan Lens Options
- IPG controller & Software or XY2-100 Interface
- Pre-Calibrated Scan Fields

Ultraviolet Integrated Scanner 355 nm

Green Integrated Scanner 515 nm

Infrared Integrated Scanner 1064 nm

Picosecond Integrated Scanner 1030 nm

MICROPROCESSING Systems

HIGH-PRECISION & HIGHLY CONFIGURABLE

- Granite based platforms for repeatable, high-precision machining
- Beam delivery configurable to match laser sources
- Fully integrated system control and coordination of all motion axes
- Automated control of multiple laser processes
- Integration with vision systems for precise process alignment
- Extensive MES communication options for easy integration
- CDRH Class 1 laser safe systems for use in any production environment without special operator precautions

MICROPROCESSING Worldwide Resources

Equipped with the latest fiber laser sources, technologies, motion systems and beam delivery components, IPG state-of-the-art applications centers are available to demonstrate the reliability, productivity and high-quality results you can expect from your microprocessing solution. Submitting your sample for evaluation ensures that the exact equipment and process variables are determined to best match your specific application. Our industry leading knowledge of microprocessing applications optimizes your fiber laser solution deployment.

PREMIERE **APPLICATIONS LABS**

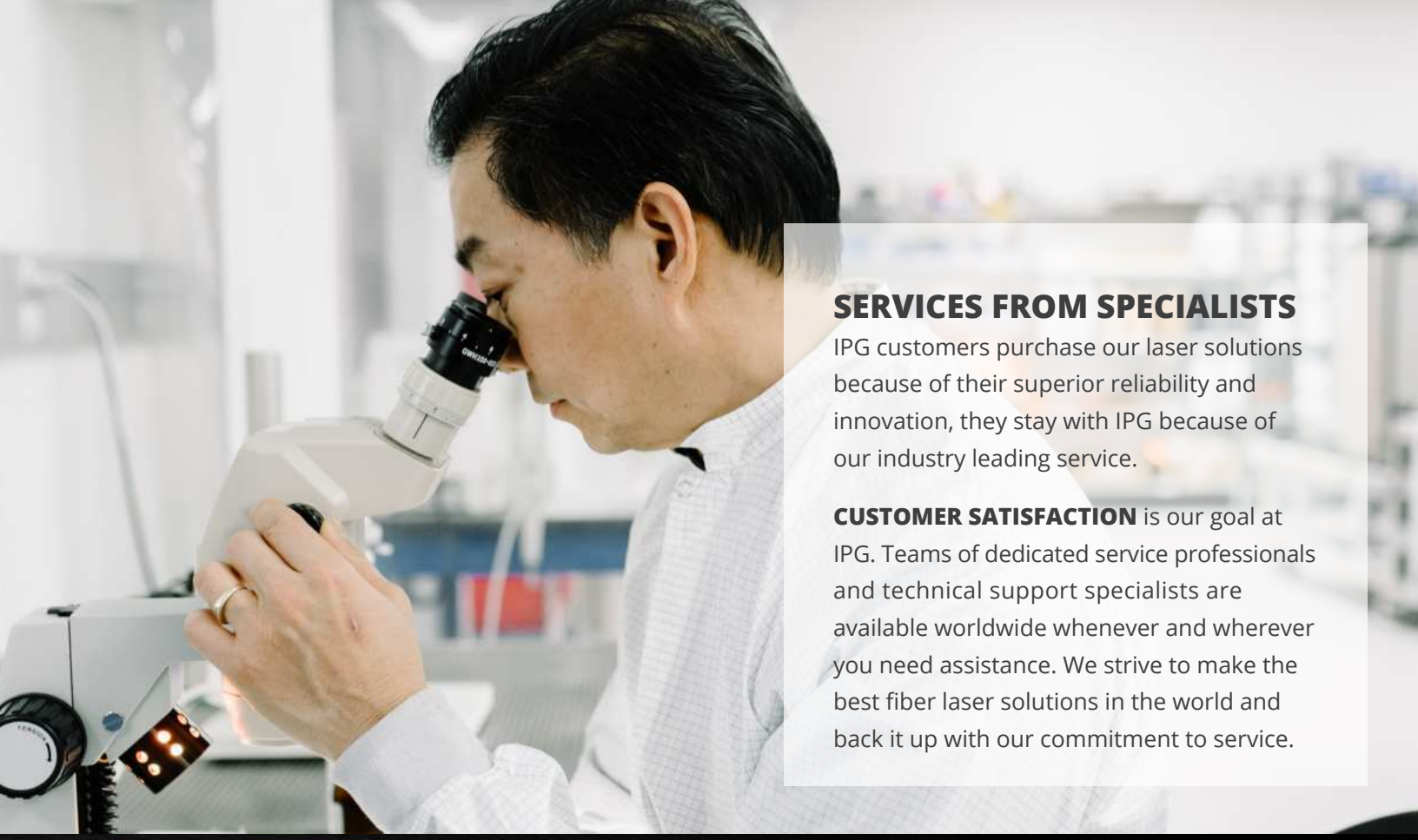
Our application engineers, developers and scientists in our applications labs provide you the opportunity to learn and investigate how we develop solutions that optimize your product development and manufacturing capability.

DISCOVERING YOUR NEXT MICROPROCESSING SOLUTION IS EASY

1. Send us a sample for evaluation or your project requirements and our experienced application engineers will deliver a detailed report with recommendations for a fiber laser microprocessing solution to best match your application.

2. Visit and experience a live, customized microprocessing demonstration of laser source and beam delivery options at one of our **26 applications centers** worldwide.

3. From there we help with process development to fully scaled production, plus installation through application optimization to maximize the throughput and quality of your components.



SERVICES FROM SPECIALISTS

IPG customers purchase our laser solutions because of their superior reliability and innovation, they stay with IPG because of our industry leading service.

CUSTOMER SATISFACTION is our goal at IPG. Teams of dedicated service professionals and technical support specialists are available worldwide whenever and wherever you need assistance. We strive to make the best fiber laser solutions in the world and back it up with our commitment to service.

IPG Photonics is the world leader in fiber laser technology, enabling greater **PRECISION**, higher **PRODUCTIVITY** and more **FLEXIBLE PRODUCTION** providing our customers **THE POWER TO TRANSFORM** materials across any application and industry.

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