

# KunLun Advance Material Technology

Micro Injection Molding and Micro Assembly Services



## • Intraocular Pupil Expander

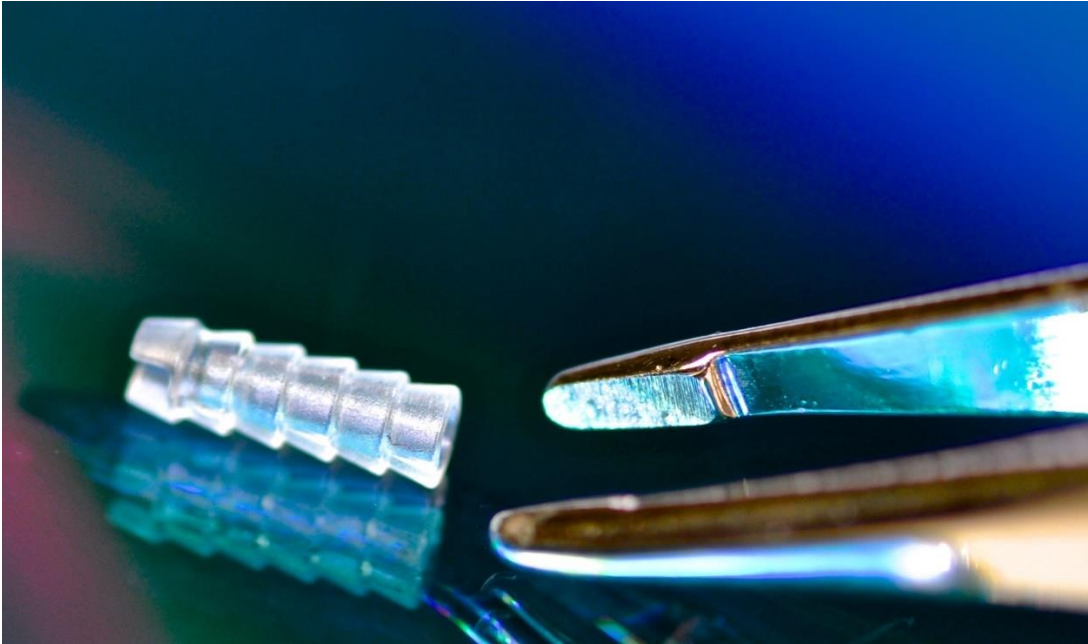
This pupil expander is an interlocking, spring-loaded, intraocular device with micron sized parting lines in the hook area—contributing to patient comfort.

**Dimensions**

8.3mm x 1.7mm x 0.3 mm (0.326" x 0.67" x 0.011" )

**Material**

Nylon, Medical Grade, Class VI



## Dissolvable Polymer Suture Anchor

This bioresorbable suture anchor is made with dissolving polymers for time release of compounded drug infused polymers which are dissolved by the body as carbon dioxide and water. Mold design is critical to micro injection mold shear and heat stress risk mitigation. Micro mold designs are customized for immediate return on investment for high value materials such as implantable PEEK, PLA, PLLA, and PLGA.

**Dimensions**

3.0mm x 0.5mm dia (0.120" x 0.020" dia)

**Material**

PLLA Bioresorbable Polymer



## Glaucoma Drain

This glaucoma drain was micro molded in Class VI polypropylene. This Class III device uses the pressure of the eye to drain through the wedge-shaped core. A radial side action core shuts off on the end of its throw onto a 0.006" hole without leaving flash. The core pin is piloted to provide risk mitigation for core deflection during high injection pressures.

### **Dimensions**

8.0mm x 2.0mm x 0.50mm (0.315" x 0.080" x 0.020")

### **Material**

Class VI Polypropylene (co-polymer)



## Bioresorbable Orthopedic Implant

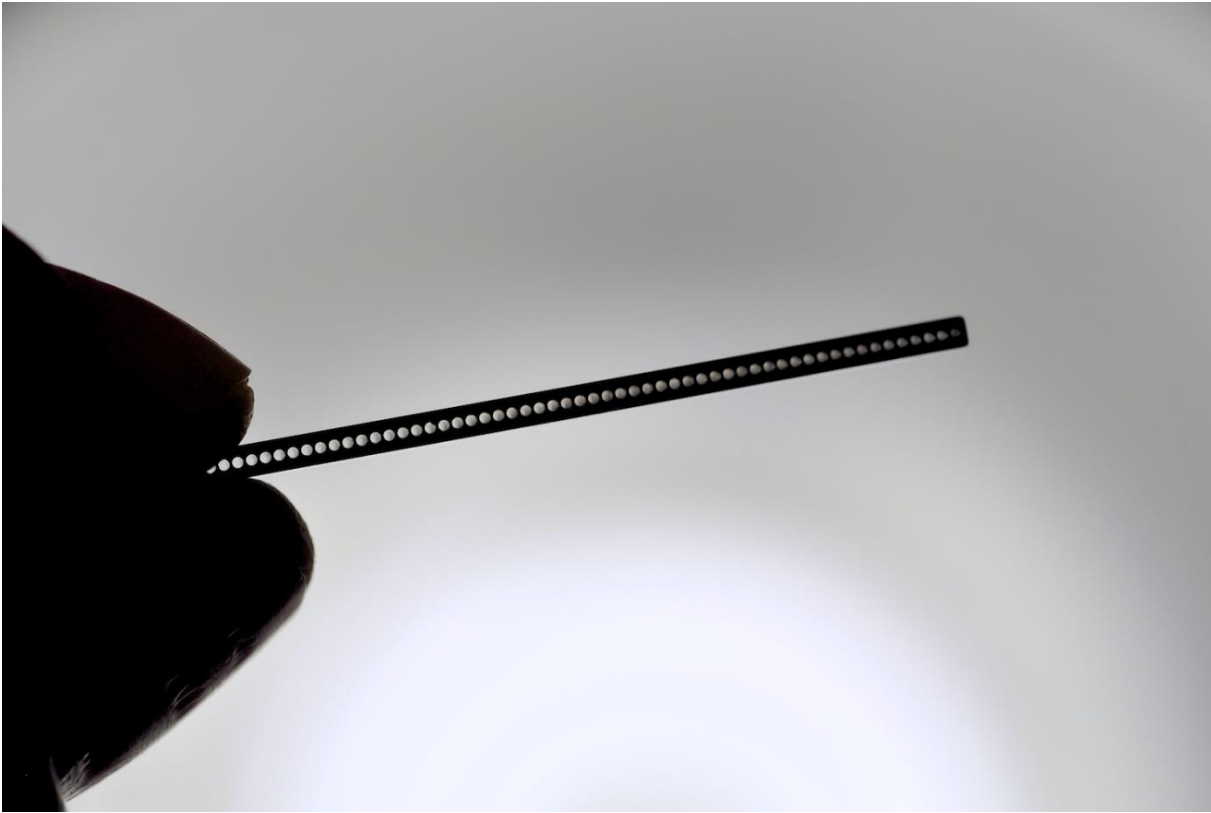
This 4mm long PLLA orthopedic suturing implant has 0.008" suture holes.

### **Dimensions**

4.0mm x 1.5mm x 1.5mm (0.160" x 0.060" x 0.060")

### **Material**

Poly(L-lactic acid) "PLLA"



## Fiber Optic Connector

This fiber optic connector has 0.010" holes with 0.004" walls in between. Thin wall, high aspect ratio PEI (Ultem) micro molded parts require high precision mold making capabilities. The thinnest wall thickness molded at Kunlun was 0.001" thick, requiring cavity to core interlocks and 0.0001" core to cavity total run out.

### **Dimensions**

15.9mm x 0.2mm dia holes (0.625" x 0.008" dia holes)

### **Material**

Ultem (PEI)



## Implantable Port

This polycarbonate implantable port replaced a machined prototype with one micro molded part. This part has tiny orifices of 0.004" piloted from A to B side of the mold to prevent core deflection during injection.

### **Dimensions**

7.0mm x 8.0mm x 0.5mm (0.275" x 0.315" x 0.020")

### **Material**

Polycarbonate



## Orthopedic PEEK Micro Implant

This 5mm meniscus repair implant is micro molded from implantable PEEK. Post-annealing AFTER assembly allows improved bonding of semi-crystalline structures. Some examples of micro molded PEEK implants are heart valves, thin-walled catheter tips, bone screws, spine cages, and dental anchors to name a few.

### **Dimensions**

5.0mm x 1.2mm dia (0.196" x 0.047")

### **Material**

Implantable grade PEEK





# Intraocular Drug Delivery Device

Intraocular Drug Delivery Device Assembly. Five components, full automation system, molds, validation, FAT, SAT installed on drug delivery device company site.

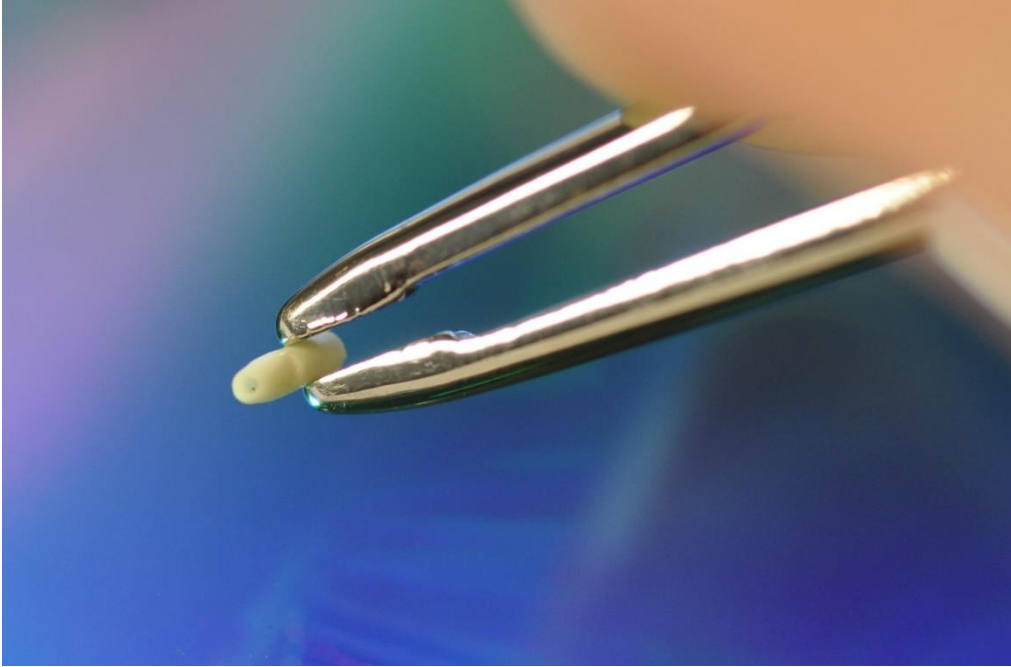
## **Dimensions**

3.0mm x 1.5mm dia (0.120" x 0.060" dia.)

## **Material**

Polycarbonate, SS





## Suture Anchor

This TPE suture anchor is 0.160" long with 0.004" side action suture holes. Micro molding TPE provides the ability to select the necessary durometer without the challenge and cost of silicone molding.

### **Dimensions**

4.0mm x 1.5mm dia. (0.160" x 0.060" dia.)

### **Material**

Thermoplastic Elastomer ("TPE")



## Endoscopic Port

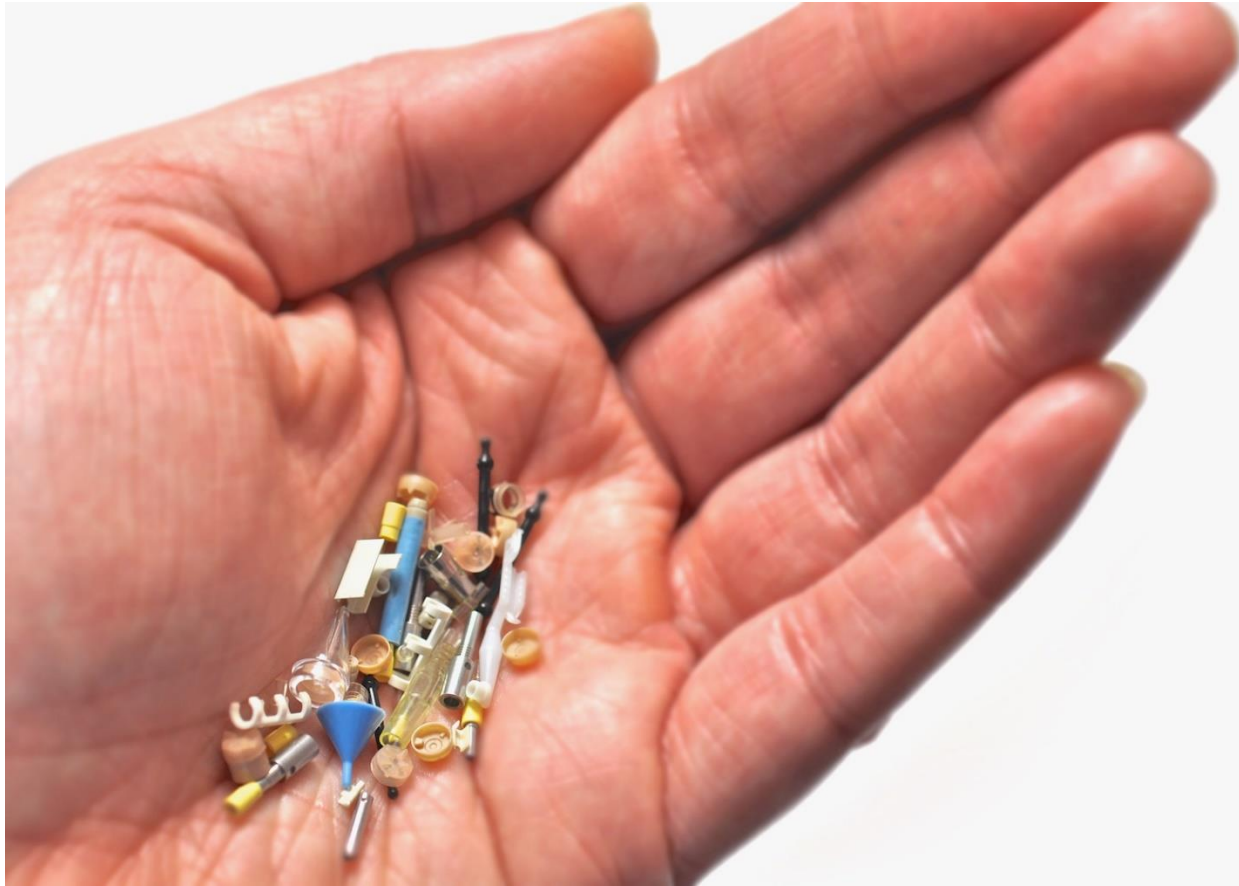
This polycarbonate endoscopy guide solved a problem, with 3 machined prototype parts being combined into one micro molded part. A very large cost savings and validation costs were realized for this surgical device OEM.

### **Dimensions**

12.7mm x 10.7mm x 9.27mm (0.500" x 0.420" x 0.365")

### **Material**

Acrylic



# Micro Molding

Multiple Micro Molded Components. 25 years of experience in micro mold building, micro molding, micro automation, and micro assembly

## **Dimensions**

4.0mm x 1.5mm x 1.5mm (0.160" x 0.060" x 0.060")

## **Material**

ABS, Acetal, Pebax, Nylon, Polyethylene, Polypropylene, PEEK, PTFE, Ultem, Urethane, PGA, PLA, PLLA, Polycarbonate, Polyurethane, Polysulfone, LCP



## Bioresorbable Needle

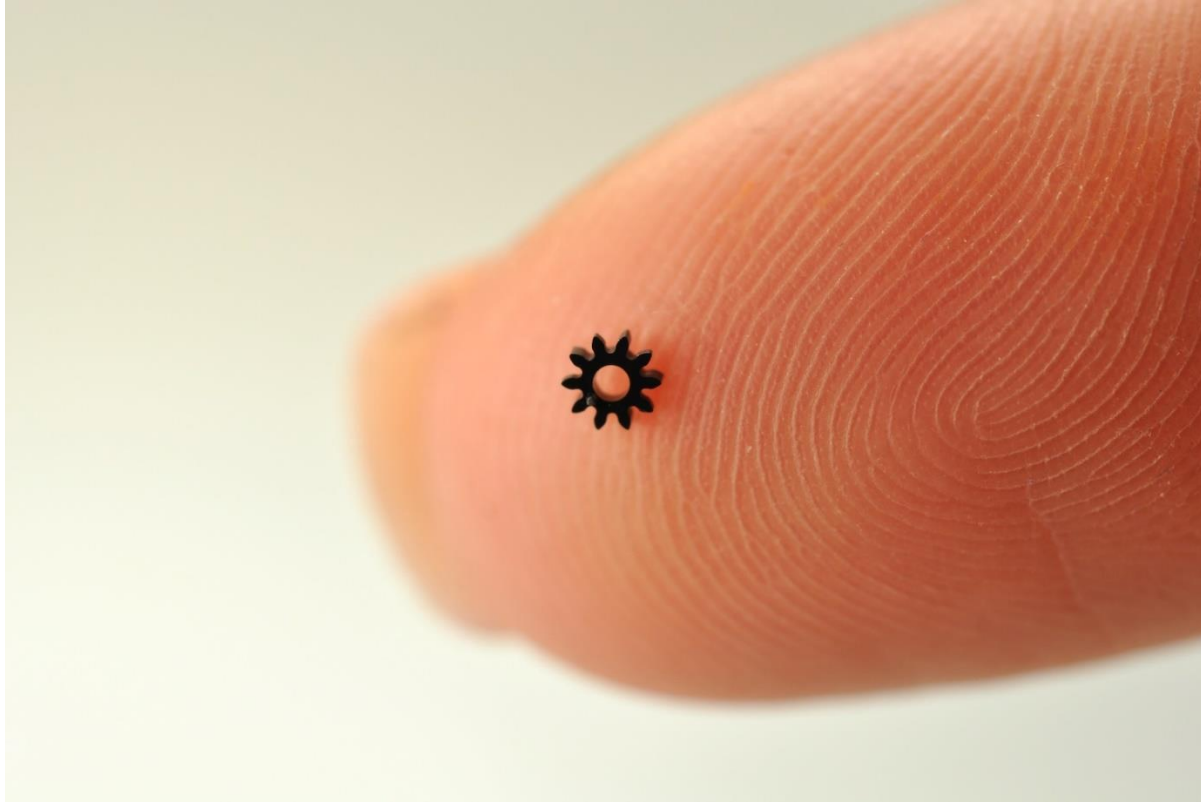
This 5mm long PLLA tissue anchoring implant has very sharp 0.006" high barbs and a multi-faceted piercing geometry for piercing tough and highly elastic tissue.

### **Dimensions**

5.0mm x 1.0mm dia. (0.200" x 0.040" dia)

### **Material**

Poly(L-lactic acid) "PLLA"



## PEEK Micro Gears

PEEK, PEI, PES, PSU, and other high heat material gears are enabled by the precision of the micro mold design and fabrication process.

### **Dimensions**

0.5mm dia x 0.15mm (0.020" x 0.006")

### **Material**

PEEK





## ENT Device

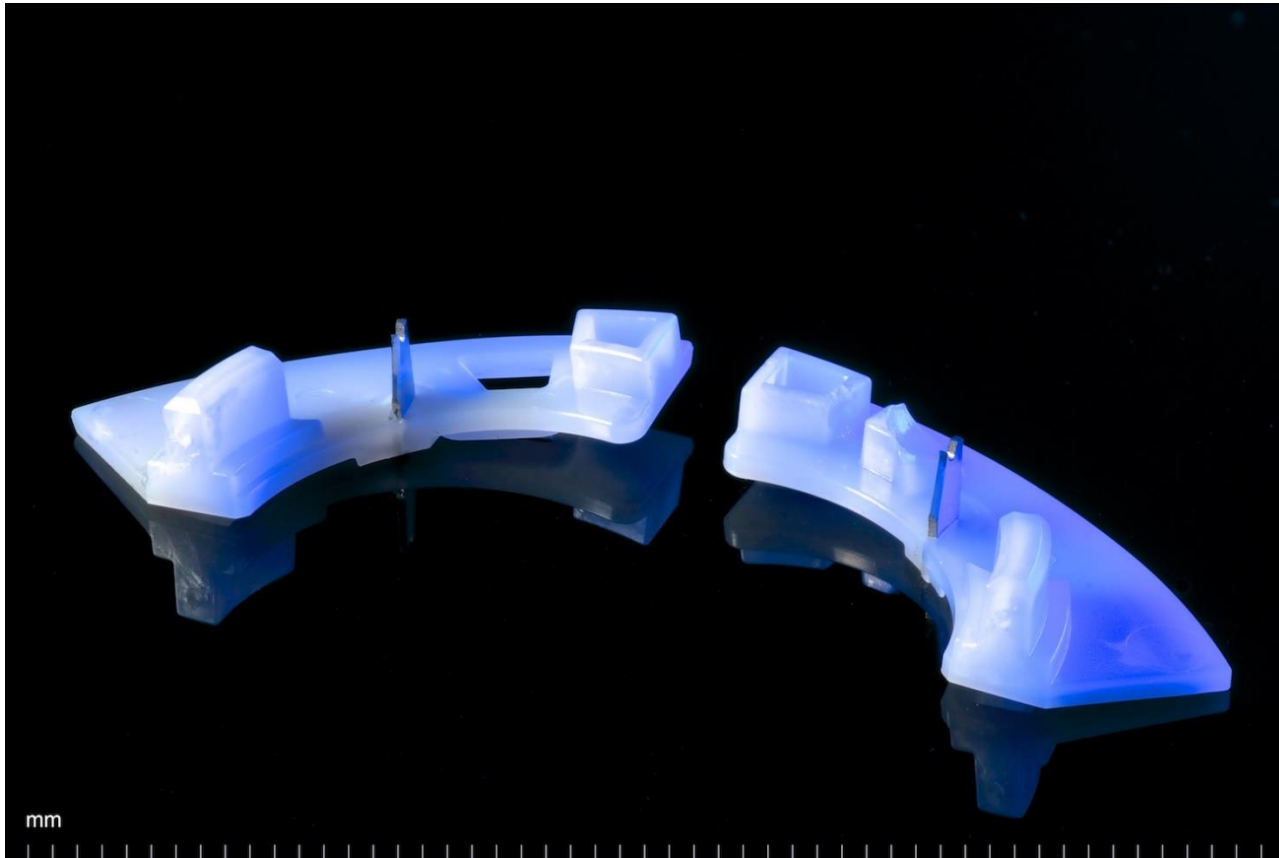
This ENT device is an example of two-shot micro molding, and is an insert molded polycarbonate shaft over a TPE spiral component.

### **Dimensions**

17.8mm x 3.8mm dia (0.700" x 0.150" dia)

### **Material**

TPE over Polycarbonate



## Inhalation Device Blades

These 12 mm inhalation blades were designed and built by Kunlun's prototype to pilot team. The blade designs were selected for DFM for high volume production capability. Bioburden and particulate rates are critical to drug delivery devices that are in contact with active ingredients such as these.

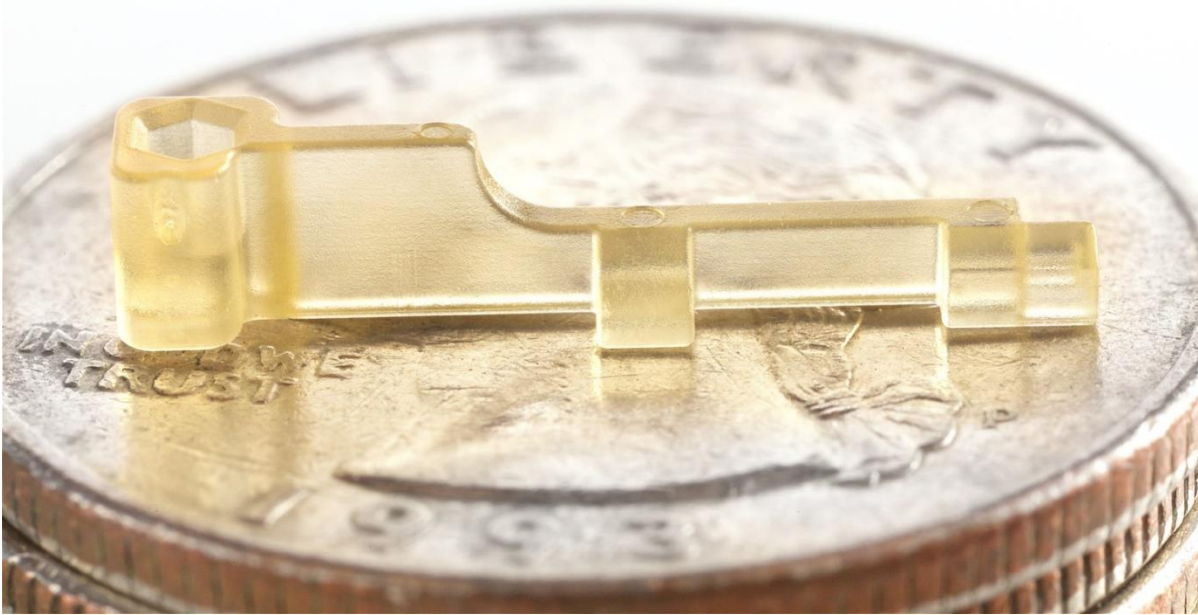
### **Dimensions**

10.0mm x 3.0mm x 0.5mm (0.4" x 0.120" x 0.020")

### **Material**

PC/ABS Blend Holder & Stainless Steel Blade (overmolded)





## Surgical Latch

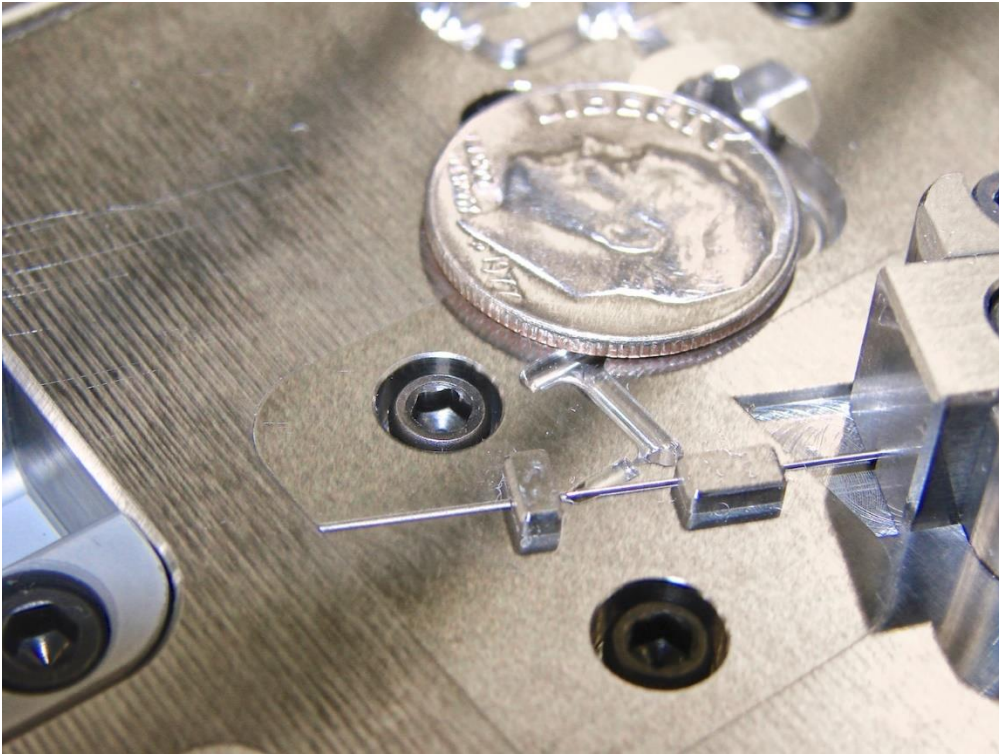
This surgical latch is micro molded from PEI and was designed with zero draft for the hexagonal pivot to fit the mating components accurately.

### **Dimensions**

15.0mm x 2.2mm x 0.5mm (0.605" x 0.085" x 0.020")

### **Material**

Polysulfone



## Cannula Sleeve

This polycarbonate cannula sleeve has a 0.006" side action hole as shown in the micro mold. The core pin is guided through two locally situated guides to prevent core deflection during injection.

### **Dimensions**

2.0mm x 0.2mm dia (0.080" x 0.008" dia)

### **Material**

Polycarbonate



## Cap

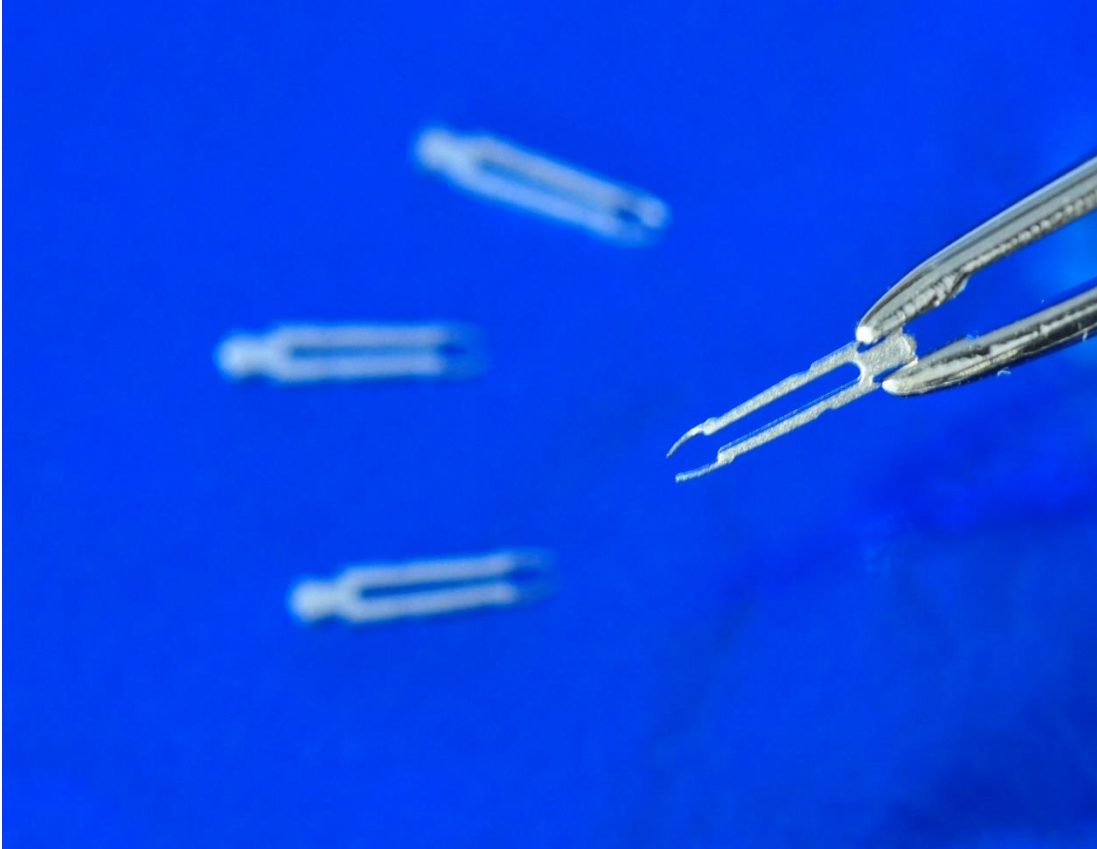
This nylon cap is micro molded and automatically packaged using molding press side automation and double bagged in a Class 7 cleanroom.

### **Dimensions**

5.6m x 3.0mm (0.220" x 0.120")

### **Material**

ABS



## Machined Tissue Handling Device

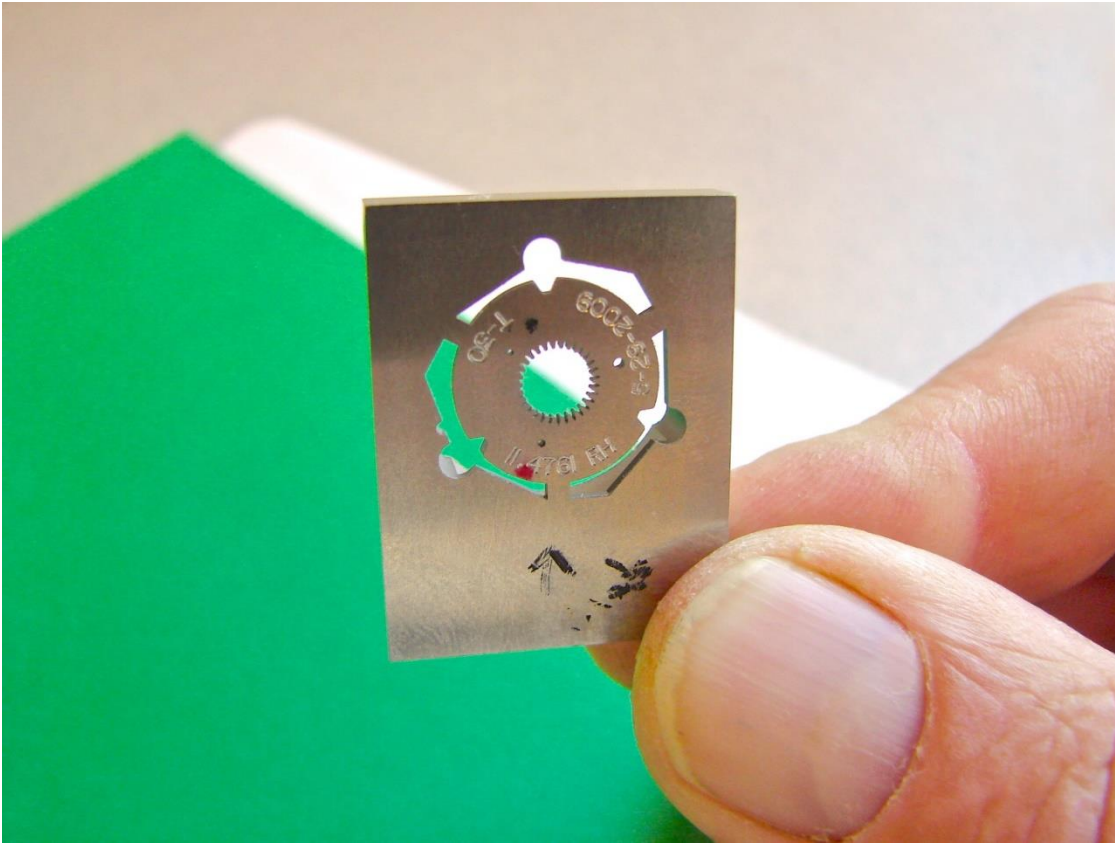
Micro molded prototypes are often machined to address feasibility. The machining of the mold, automation fixtures, and prototypes are the enabling technologies for micro molding and micro assembly.

### **Dimensions**

6.6mm x 1.0mm x 0.25mm (0.260" x 0.040" x 0.010")

### **Material**

Stainless Steel



## Gear Electrode

Micro Gear Electrode- 0.008" thin wall gear electrode

Micro mold design requires micron level precision and laminated construction for proper venting. Windage is built into the molds such that single micron tolerances can be achieved.

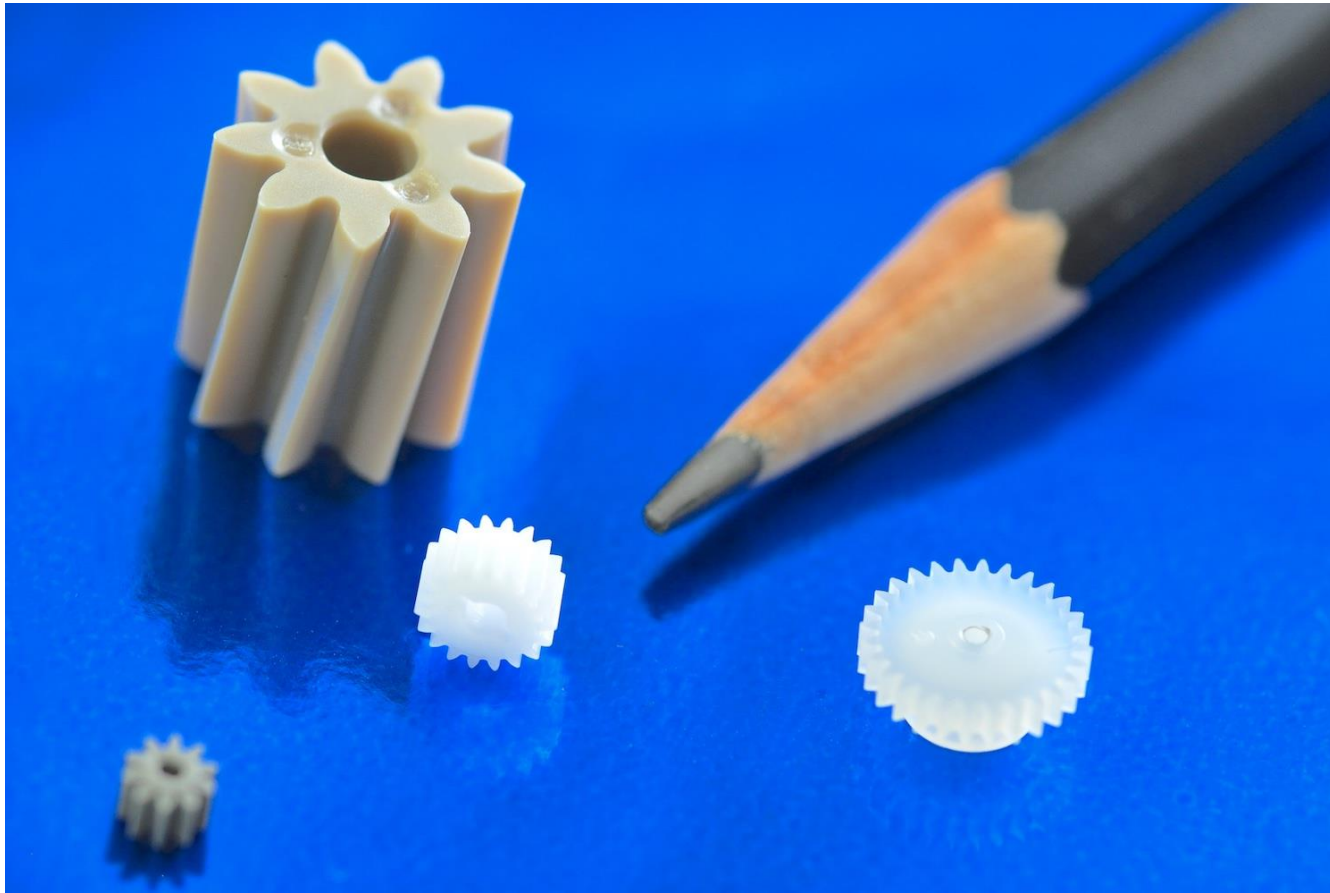
### **Dimensions**

4.0mm x .0.2mm thick (0.160" x 0.008")

### **Material**

Copper Tungsten





## Micro Gears

Micro gears are especially precise due to the gear to gear and profile tolerances for proper gear function. Kunlun has been molding gears for decades with extreme precision.

### **Dimensions**

4.0mm to 1.0mm (0.160" to 0.040")

### **Material**

PEEK, Acetal, Carbon-filled LCP, Nanotube-filled LCP



## Micro Connector Mold

Pins as small as 0.008" diameter are assembled with automation at the molding press to reduce setup errors, particulate in handling, datum errors, and bioburden rates.

### **Dimensions**

17.0mm x 2.5mm (0.670" x 0.100")

### **Material**

SS



# AUTOMATED ASSEMBLY

At the micro level, manual assembly is cost prohibitive and requires a level of dexterity that is impractical to avoid introduction of errors the magnitude of which is unacceptable when dealing with micron tolerances.

It is vital, therefore that your chosen micro mold manufacturing partner has automated assembly solutions that achieve exceptional results, the combining of what are often dust-speck sized parts with other dust-speck sized parts requiring extreme positional accuracy and an in-depth understanding of the methodology of micro assembly.

## MICRO ASSEMBLY CAPABILITIES

The key objective in automated micro assembly is to reduce the number of times parts are handled, as each time a micro component is “let-go” from a surface, additional error can be introduced. With over 15 years experience in micro automation and assembly, Kunlun Micro Molding Team has developed discrete and ultra-precision capabilities in automated assembly of micro medical and drug delivery devices. Full systems are designed and fabricated in-house, and include the integration of PLC logic, inline vision inspection systems, micro dispensing, solvent bonding, UV curing, and inline pressure decay leak testing.

We are the professional micro injection molder in China — and one of very few globally — that has the in-house capability to produce fully automated and integrated micro assemblies and devices. This allows us to successfully manufacture components and sub-assemblies such as intraocular drug delivery devices, transdermal patches, ligating clips, intraocular implants, orthopaedic anchors, microfluidic devices, robotic and endoscopic surgery devices, and neurovascular implants to name but a few.

Devices such as intraocular drug delivery devices, transdermal patches, ligating clips, intraocular implants, orthopedic anchors, microfluidic devices, robotic and endoscopic surgery, and neurovascular implants are some of the examples of polymer components and sub-assemblies Kunlun has brought to production.

## SYSTEM FEATURES

- Pneumatic or servo actuated
- Fool-proof laser safety systems
- Touchscreen machine controls
- Data capture and storage systems

- Networking to manufacturing plant IT systems
- Precision function controls  $\pm 0.0001''$  (0.0025 mm)
- Nano precision components to  $0.00004''$  (1 micron)
- Pick and place equipment manufacture

## **CUSTOM MICRO AUTOMATION**

- Precision self-contained semi and full automated assembly cells
- Single and multi-station assembly, test, and inspection systems
- Integrated clean rooms built to specified class
- Bench top assembly fixtures and handheld devices
- Ultra precision bonding and fastening operations
- Automated micro-machining cells" (0.0025 mm)



# MICRO MOLD MANUFACTURING

We provide a complete end-to-end solution for precision component design and micro mold manufacturing. Uniquely, we are able to fulfill product design and development, process development, tool design and fabrication, micro injection molding, and assembly automation solutions all under one roof. We have a team of engineers, toolmakers, and production staff that all work to reduce and ultimately eliminate the risks associated with the manufacture of the most complex and precise micro molded components and assemblies.

## MICRONS MATTER™ RISK MITIGATION

We have developed the Microns Matter™ best-practice risk assessment strategy which is used for the development and high-volume production of critical-to-function micro molded devices on behalf of our customers. Mitigating risk is our fundamental goal, and we use state of the art equipment and process validation tools to ensure success. We adhere to an engineering-based strategy of plan, plan, plan, and then execute.



Mitigating Risk is Our Goal	State of the Art Equipment	CT Scanning to 0.1 micron resolution
DFM/DFQ Analysis	Mold-Flow Analysis	Micro Application Expertise
Root Cause & Failure Mode Analysis	IQ/OQ/PQ Validation	Plan, Plan, Plan, Execute
Micro Injection Mold Design & Fabrication	Robust Process Design	Product Design & Development
Micro Automation Design & Fabrication		

## MATERIAL EXPERTISE

We offer expertise at every stage of the design to manufacturing process. In addition to micro mold manufacturing design, tooling, processing, and assembly knowledge, we also have vast experience processing many types of exotic materials and high engineering thermoplastics.

So, whether your application requires multiple materials for the most intricate over-molded component, a tiny medical implant, or a microfluidic chip with tolerance of a few microns, we have the materials knowledge, experience, and understanding to achieve success.

- Acetal
- Polyester/Co-polyester
- PEEK
- PTFE
- Polyolefins (Polyethylene, Polypropylene)
- ABS
  
- PGA
- PLA
- TPE and TPU (Thermoplastic Elastomers and Urethanes)
- Tecothane™
- Polysulfone
- Poly-Ether-Sulfone
  
- Acrylic
- LCP (Liquid Crystal Polymer)
- Polycarbonate
- Cyclic Olefin (COC, COP)
- Nylon
- Polyetherimide (Delrin, Celcon)

# COMPLEX FEATURE MICRO MOLDING

Tooling is the key enabling technology when it comes to the success or failure of a micro injection molding project. Often, medical device OEMs find themselves working with medical micro molders that do not take a holistic view of the design and manufacturing process, and do not understand the absolute importance of an expert tooling program.

Kunlun Micro Molding has precision tool making at its core. This, along with a complete understanding of all the aspects of micro design and manufacturing, means that we are able to manufacture extremely accurate medical device parts and components from high performance polymers with the following complex features.



## FEATURE EXAMPLES

Total part weight from 0.0001 grams

Profile and positional accuracy to single microns (0.00004")

Precision threads/gears to micron tolerances

Wall thickness from 0.001" (0.04mm)

Mold core diameters less than 0.002" (0.05mm)

## **MICRO MOLD TYPES AND MATERIALS**

Our tooling and micro mold making experience spans several decades and we have worked in the most technologically advanced market-places. One size certainly does not fit all when it comes to making precision tools, and it is vital that a tool maker working in the micro manufacturing sector understands the affect of material, cycle-time expectations, part criteria, and expected volumes etc... when making a tool.

Kunlun Micro Molding has vast experience manufacturing micro molds for a wide variety of materials such as, PEEK, polyurethane, Pebax™, nylon, polycarbonate, silicone, urethane blends, and radio-opaque compounded formulas for the medical device industry, as well as almost all other thermoplastics. We have extensive materials knowledge stretching back decades.

- Complex Technical Molds
- Two-Shot
- Servo Unscrewing
- Insert Molding
  
- Micro Molds
- LSR
- Reel-to-Reel
- Overmolding

## **MICRO MOLD MANUFACTURING CAPABILITIES**

At Kunlun Micro Molding, we machine and verify our tools to micro precision specifications of +/- 1 micron. Our state-of-the-art precision machining cell utilizes a 600x magnification vision inspection system that captures images of an end mill at full rotation with surface speeds up to 1000 in/sec. The machine auto-corrects using the images as programmable offsets sent to the workpiece. This level of sophistication is required for Kunlun Micro Molding to machine double-fluted end mills with 10-micron diameters.



At Kunlun Micro Molding we use micro hard milling, sub 0.001" diameter wire EDM, and micro sinker EDM technology to deliver the highest level of accuracy and surface finish possible. Our micro mold making equipment uses sophisticated on-board inspection probes and high speed vision systems to ensure the integrity of our micro sized cutting tools.

- Micro milling with 10µm end mills
- Wire EDM sub 0.001" diameter
- Hole popping
- Laser micro engraving
  
- Precision OD grinding
- Micro sinker EDM
- CMM inspection
- Laser welding

# MATERIALS KNOWLEDGE

There is no substitute for in-depth polymer material expertise when micro molding. Kunlun Micro Molding's knowledge of materials stretches back decades, and importantly — and distinct from many other manufacturers — our experience is entirely focused on micro molding and thin-walled devices. Micro manufacturing and precision is in our DNA. It is all we do!

Kunlun Micro Molding can partner with its customers from design to volume manufacture, and this is important when considering the all-important topic of design for manufacturability (DfM). DfM begins with selecting the right material for the application, taking into account factors such as rheological and shear strength properties, as well as environmental conditions associated with micro level tolerances such as humidity and temperature susceptibility.

There is no substitute for experience in material selection and the understanding of material behaviour under process conditions in micro molding. Kunlun Micro Molding's pre-eminence in this area is undisputed.

So, whatever your requirements, our plastics engineering team freely and transparently apply decades of experience and in-depth knowledge of materials for such applications as microfluidic, implantable, drug delivery, medical, and/or thin-walled micro molding applications.

- Nylon
- PEEK
- Acrylic
- ABS
  
- PLA/PLGA
- Polycarbonate
- Polysulfone
- Poly-Ether-Sulfone
  
- Polyolefins (Polyethylene, Polypropylene)
- LCP (Liquid Crystal Polymer)
- TPE/TPU (Thermoplastic Elastomers/Urethanes)
- Cyclic Olefin (COC, COP)
- Polyester/Co-polyester