



prime
optic systems

Recent Developments of Micro-optical systems in Medical Imaging

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Company



Mikrop (Wittenbach, CH)



Mikrotec (Kac, SRB)



Locations	Mikrop (Wittenbach, CH)	Mikrotec (Kac, SRB)
Employees	75	145
Production area	1'400 m ²	1'800 m ²

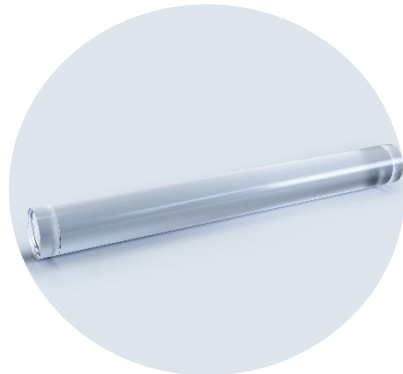
Product overview

OPTICAL COMPONENTS

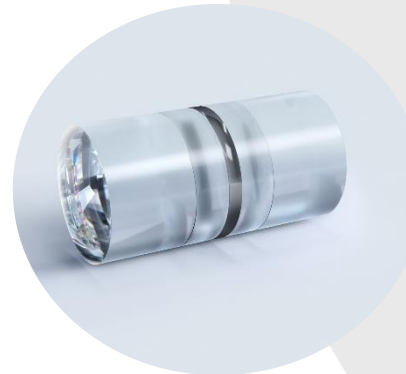
Ø 0.3 to 10 mm



spherical lenses



rod lenses



optical assemblies



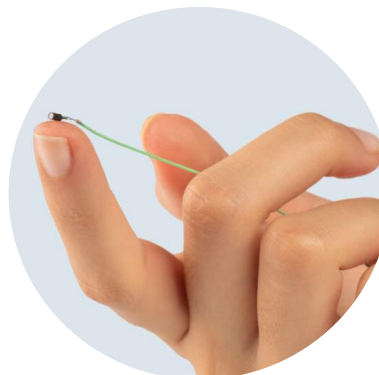
assemblies with prisms

MICRO-CAMERAS

Ø 1 to 10 mm



micro-objectives



micro-camera modules



micro-cameras

Markets and Applications



MEDICAL ENDOSCOPY

- Rigid endoscopes
- Flexible endoscopes
- HD/4K endoscopes
- 3D-Endoscopes



MEDICAL APPLICATIONS

- Dental cameras
- Telemedicine devices



TECHNICAL ENDOSCOPY

- Inspection of aircraft turbines, power stations, complex machinery



1875



2024



Micro-Optical Systems in Medical Imaging

ENCEPHALOSCOPE

RHINOSCOPE

ESOPHAGOSCOPE

THORASCOPE

MEDIASTINOSCOPE

ANGIOSCOPE

NEPHROSCOPE

GASTROSCOPE

PROCTOSCOPE

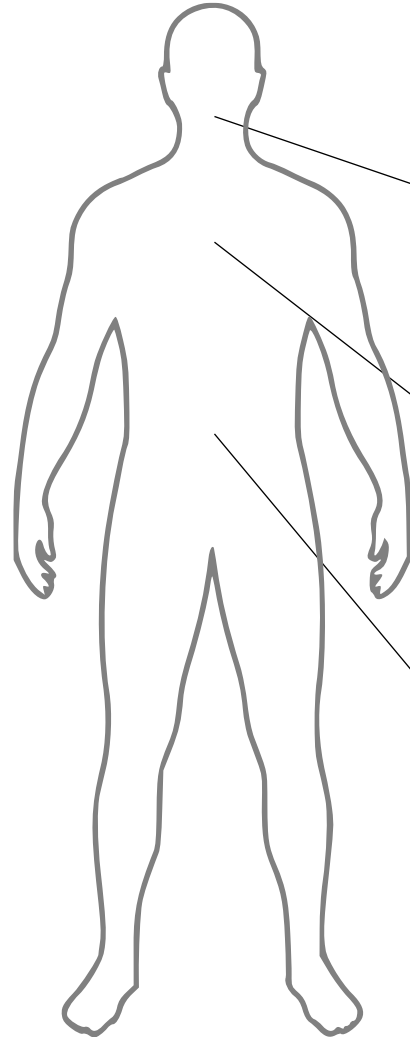
AMINOSCOPE

CYTOSCOPE

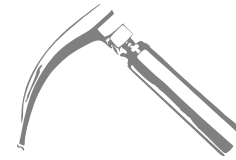
HYSTEROSCOPE

COLONOSCOPE

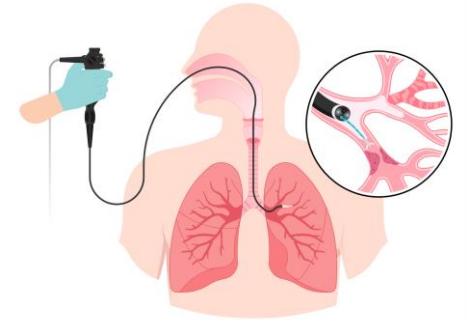
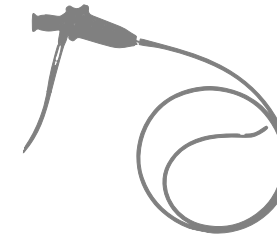
ARTHROSCOPE



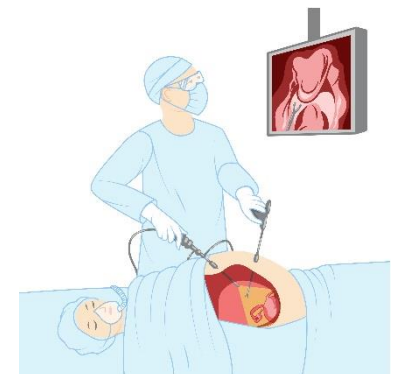
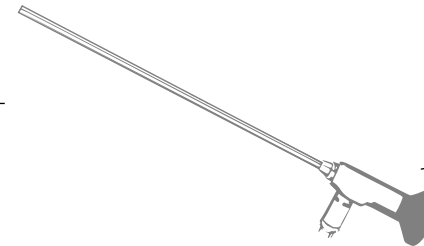
LARYNGOSCOPE



BRONCHOSCOPE



LAPAROSCOPE



Laparoscope

LAPAROSCOPY

minimally invasive surgical procedure

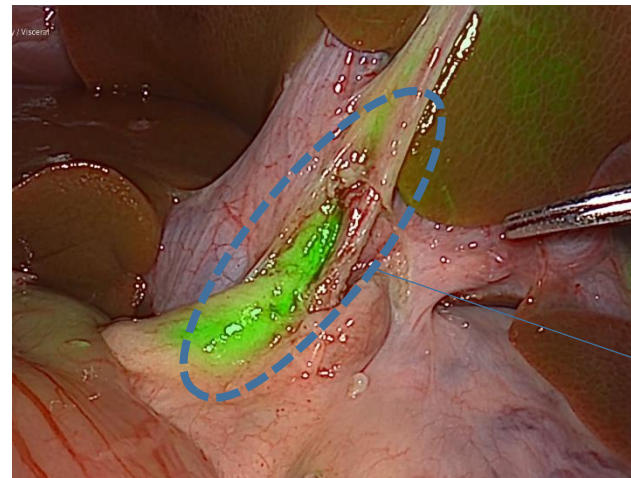
allows a doctor to view the inside of the abdomen and pelvis without making large incisions



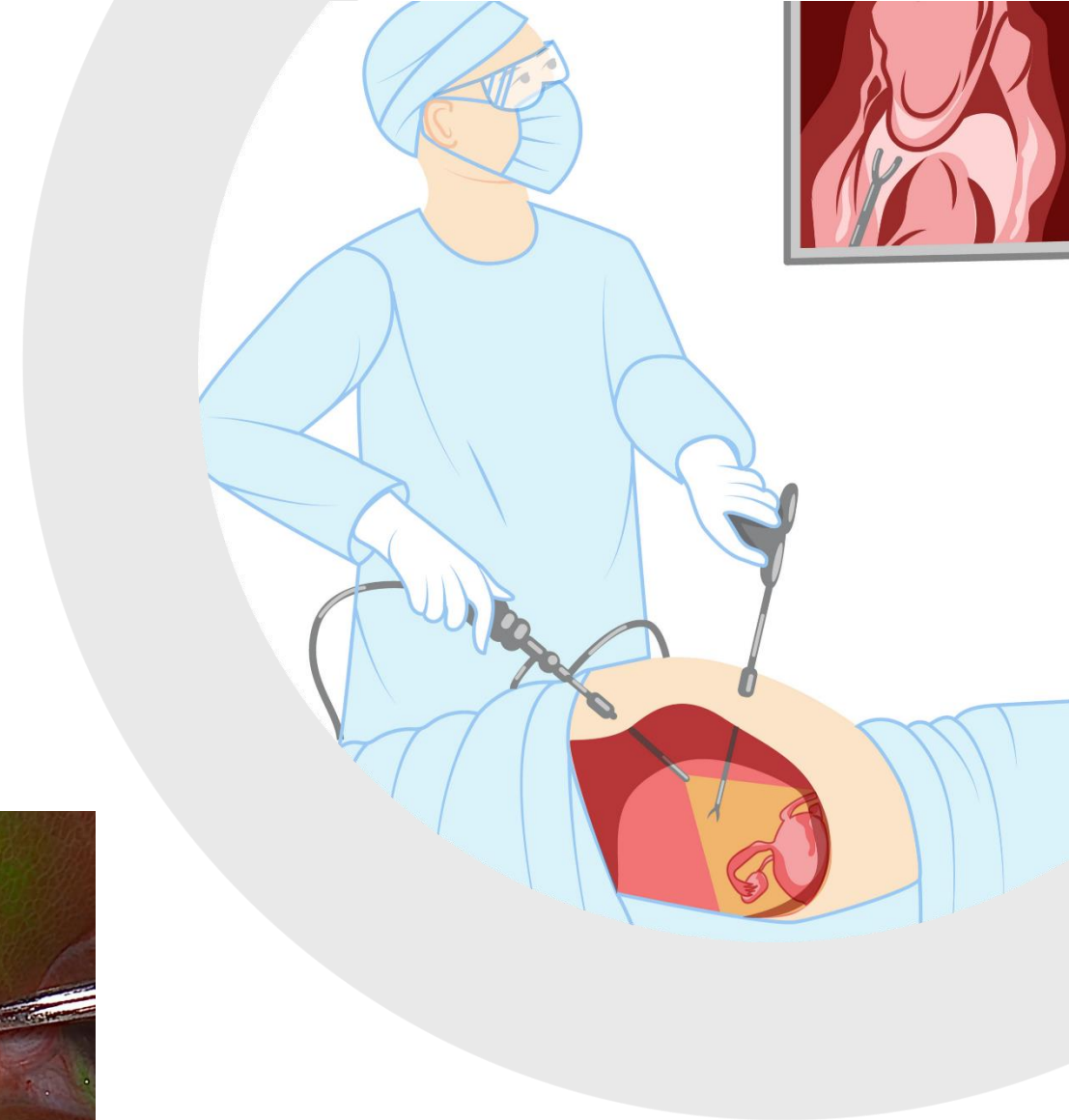
NIR-ICG-assisted laparoscope

latest generation of laparoscopic systems utilized the visual (VIS) and near-infrared (NIR) spectrum

allowing for visualization of the dye indocyanine green (ICG)



FLUORESCENCE SIGNAL
Visualization of a blood vessel



NIR-ICG-assisted laparoscope

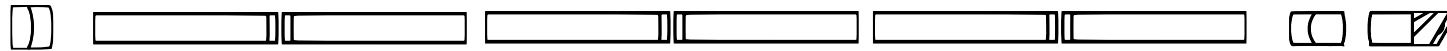


OCULAR

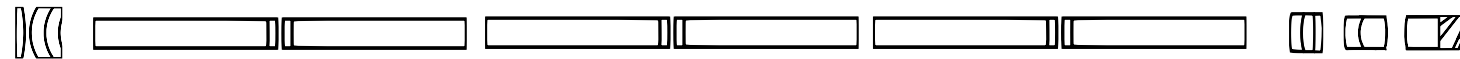
RELAY-SYSTEM

MICRO-OBJECTIVE

STANDARD SYSTEM



NIR-ICG-ASSISTED LAPAROSCOPE



COMPLEXITY
ASPHERICAL ELEMENTS



ACTIVE ALIGNMENT
TIGHT TOLERANCES



MULTILAYER AR COATING
LOW DISPERSION GLASSES

NIR-ICG-assisted laparoscope

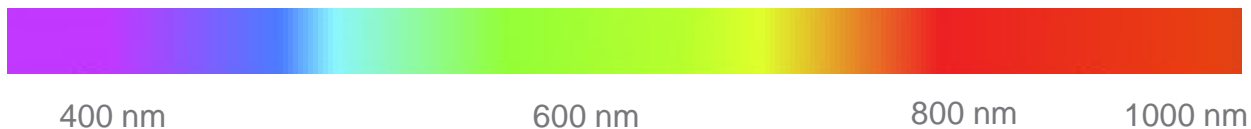
CHALLENGES

Color Aberration Correction: Achieving both axial and lateral color correction is complex due to the wide spectral range.

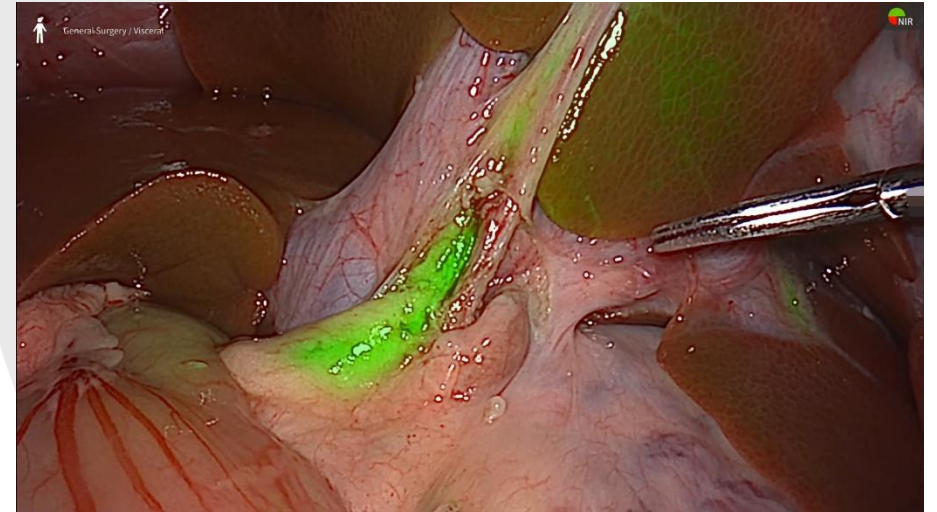
Sufficient AR Coating: Anti-reflective coatings must meet strict requirements (e.g., $R_{\text{avg}} < 0.8\%$) for optimal performance across the VIS-NIR spectrum.

Precision Assembly: High-precision alignment is necessary, with lens centration below $5 \mu\text{m}$ to ensure image quality.

spectral range from VIS to NIR



VIS and NIR image with green overlay



NIR image



3D-Laparoscope



3D VISUALIZATION

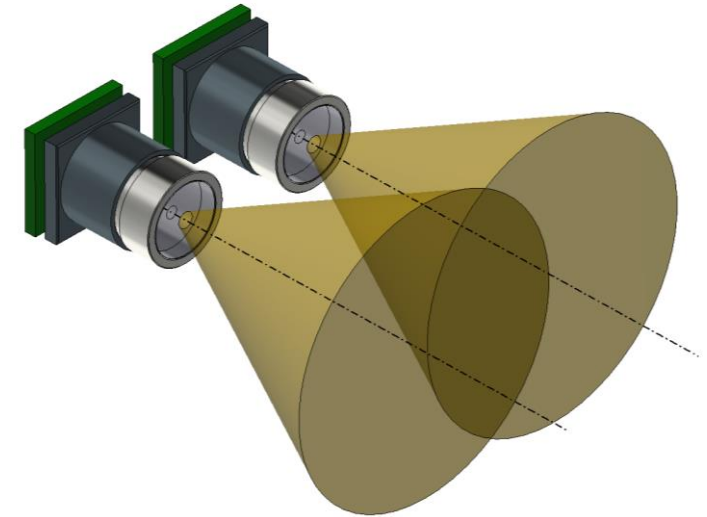
How It Works: Combines images of two camera modules to create a 3D representation

Benefits:

Enhanced depth perception

Clearer visualization of complex anatomy

STEREO MICRO CAMERA MODULE



APPLICATION

robotic
assisted
surgery



Camera Module with Plastic Lenses

CUSTOMIZED

- field of view
- working distance
- optimized spectrum
- CMOS sensor
- etc.

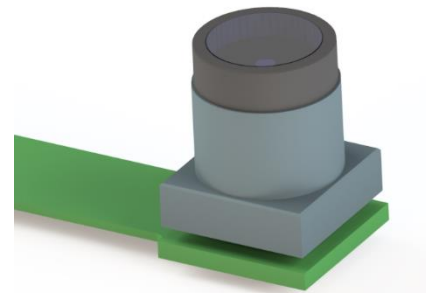
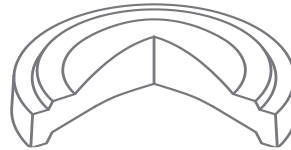
VOLUME PRODUCTION

- from prototypes to serial production

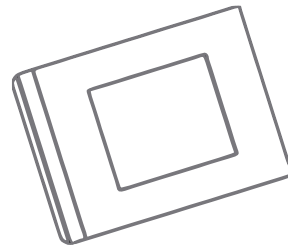
HIGH PERFORMANCE

- diffraction limited
- stray light optimized

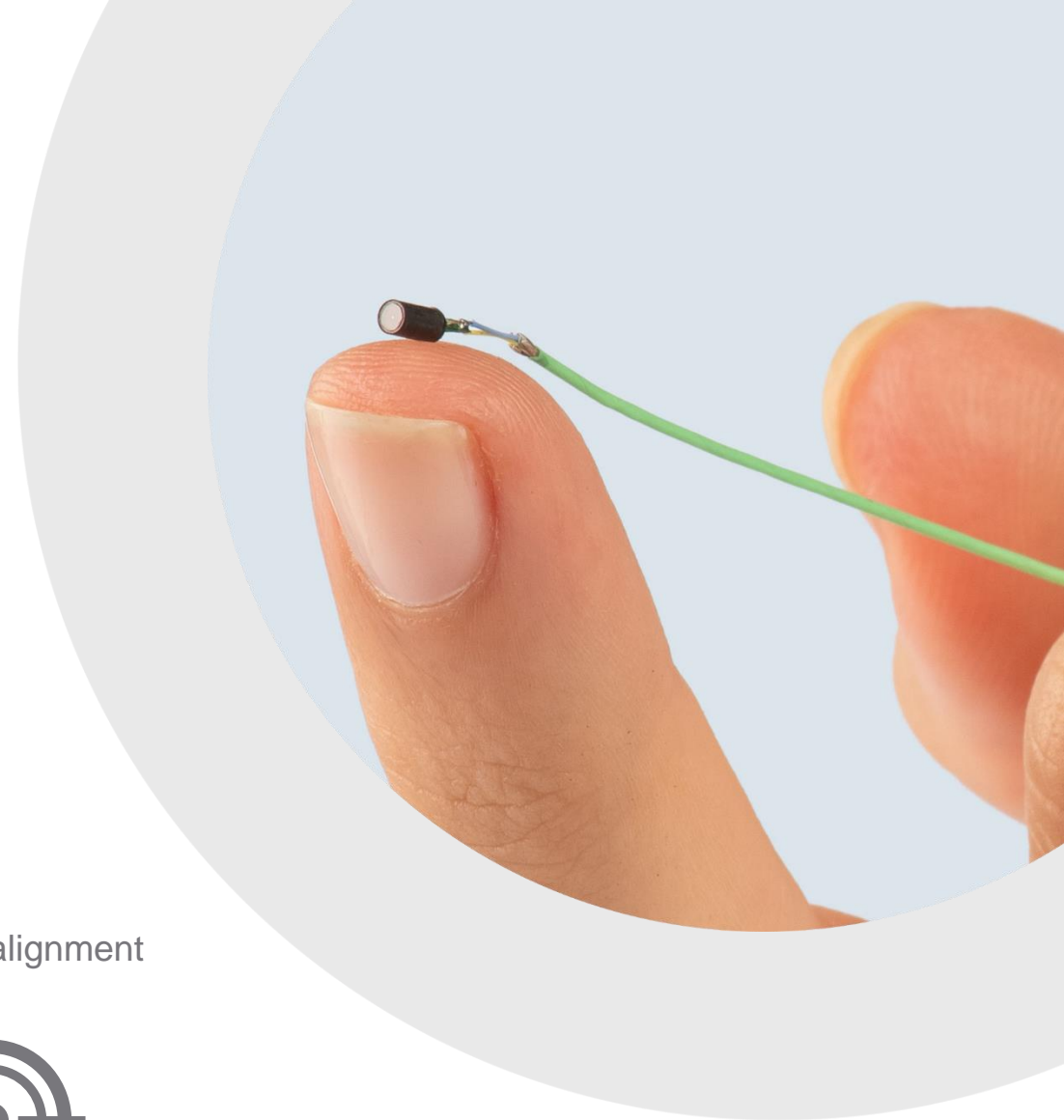
freeform lenses



high-resolution CMOS

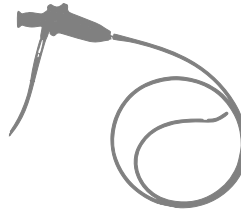
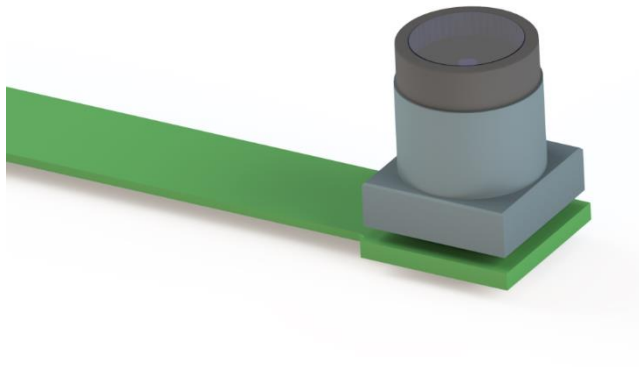


precision alignment



Camera Module with Plastic Lenses

APPLICATIONS



TELEMEDICINE

SINGLE-USE
ENDOSCOPES

PILL CAMERAS

Outlook



Further miniaturization of optical components will allow for more **flexible and less invasive** diagnostic tools



Telemedicine and single-use endoscopes will become increasingly important for reasons of cost efficiency and hygiene



Development of **tailored imaging systems** for specific medical applications (e.g. dental cameras, catheter, etc.)



THANK YOU