Innolume GmbH
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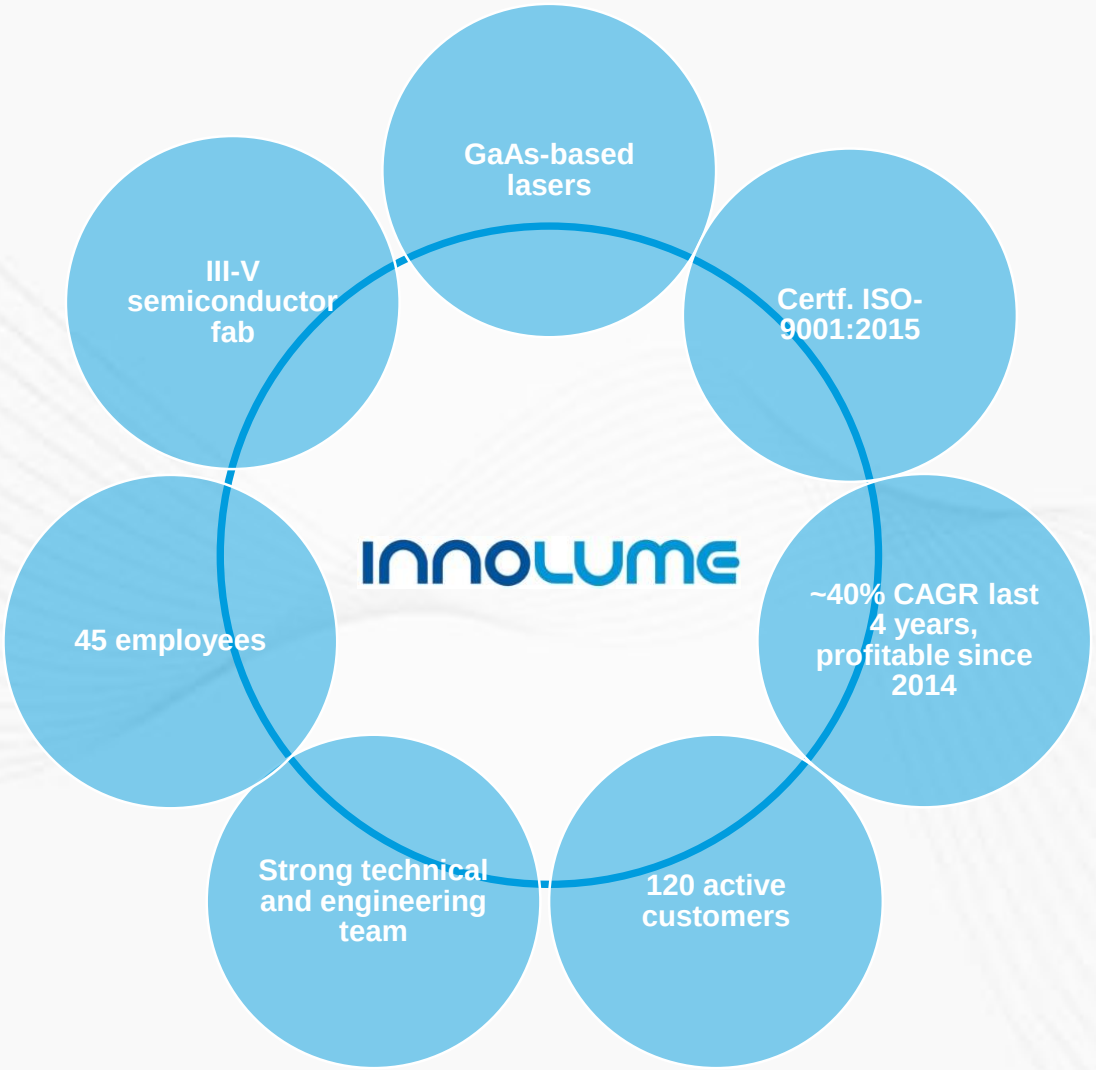
Innolume GmbH
Company Presentation /

About us

Innolume's core competency is **design, development and manufacturing** of sophisticated photonic chips based on novel **laser diode technologies in GaAs & InP** material systems targeting medical, industry, scientific and optical communication markets.

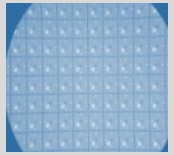


Facilities

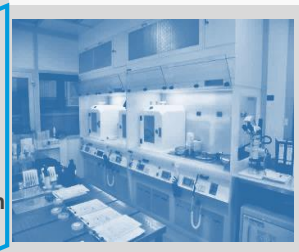
Fully vertically integrated laser diode manufacturing and packaging line of 600sqm clean room and additional 800 sqm of laboratories, offices and auxiliary premises located in the facilities of high-tech incubator *MST.factory* (https://www.mst-factory.de/en.htm) in Dortmund, Germany.

Epitaxy
MBE & MOCVD growth

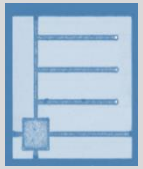
- 2 industrial level Molecular Beam Epitaxy systems
- Industrial MOCVD system
- Full characterization of epitaxial wafers



Wafer fab
Lithography
Thin-film
Etching
Metal deposition

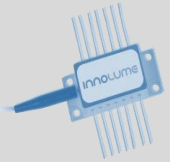


- Photo- and e-beam-lithography line
- RIE, PECVD, Vacuum deposition, Thermal Annealing, Vapor Oxidation
- SEM, Thin-film characterization

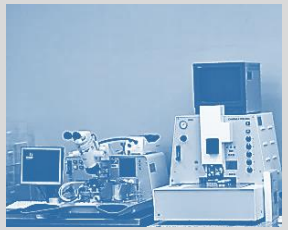


Chip fab
Chipping
Optical coating
Lifetime testing

- Scriber-Breaker, Dicing Saw
- Laser Bar handling
- Precise Optical Coating
- Pick & Place, Die Sorters



Packaging & Test
Bonding
Fiber coupling
Characterisation

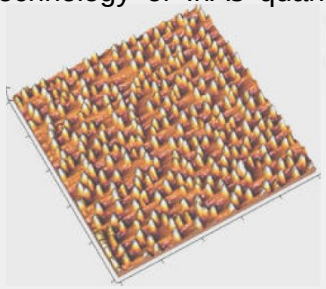


- Eutectic Die Bonders, Wire Bonders
- Fiber module assembling
- Laser characterization
- >500 channels lifetime testing
- Tens of setups for photonic measurements

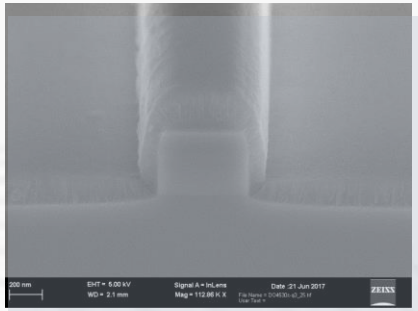
Technology

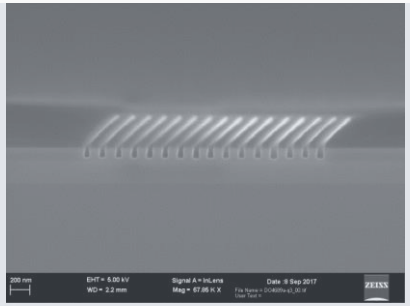
Epitaxial Growth

- GaAs- and InP- material systems (3-6” wafers)
- GaSb material system introduction planned for 2019
- Simulation and designing of epitaxial structures incl. ternary and quaternary III-V alloys
- World leading technology of InAs quantum dots



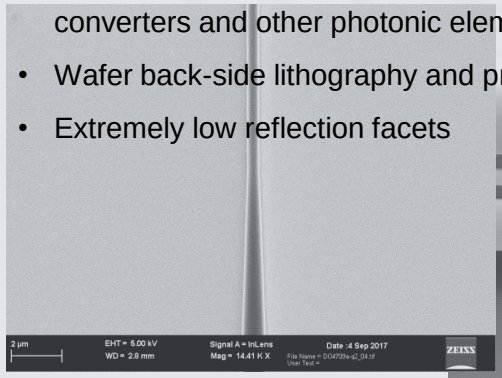
- Broad-band and narrow-band gain, quantum wells, strain compensated QWs
- Different etch-stop layers
- Digital grades
- Epitaxial regrowth incl. wafer patterning and surface preparation

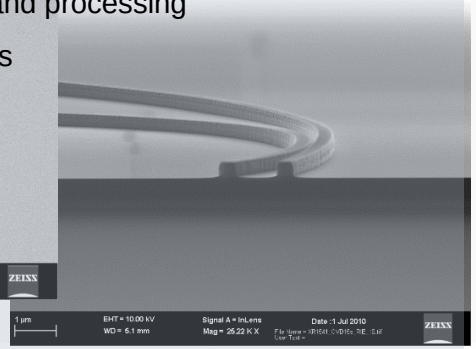




Wafer processing

- Simulation and designing of optical and e-beam lithography masks
- High precision ridge waveguide with control of “footing” formed in dry etching process
- Selective wet etching
- Precise vapor oxidation of aperture layers (for VCSEL and other devices)
- 1-st order diffraction gratings, MMI couplers, adiabatic beam converters and other photonic elements
- Wafer back-side lithography and processing
- Extremely low reflection facets





Facet Coating

- Appropriate passivation and optical coating of cleaved laser facets for highest optical power densities
- Extremely deep antireflection coatings

Chip Bonding

- High precision and low stress chip p-side-down bonding
- Designing and fabrication of specific of CTE-matched submounts

Packaging

- Designing and development of optical schemes for fiber coupling with lensed fibers, micro-lenses, optical isolators
- Laser welding technology for single mode fiber attachment (~50nm accuracy)
- Technology of epoxy attachment of micro-optical elements (~200nm accuracy)
- Coupling in PM fiber with high PER (polarization extinction ratio)
- Using of Fiber Brag Gratings (FBG) with various apodization and chirp

Design, Measurement, Analysis technologies

Simulations

- Waveguide light propagation
- Binary, ternary and quaternary heterostructures
- Different photonic elements, e.g. MMI, beam converter, chirped and apodized DBR, dispersion compensating grating, Photonic crystal
- Laser, SOA, SLD modeling incl. gain, loss, dispersion, 3rd order nonlinearities
- Laser dynamics incl. Gain switching, Q-switching, mode-locking, small signal modulation
- Dynamic characteristics of PD
- RF lines
- Laser diode coupling to fiber with micro-lenses and fiber lenses.
- Grating Surface Emitting couplers and lasers
- DFB and DBR lasers
- Phase modulators

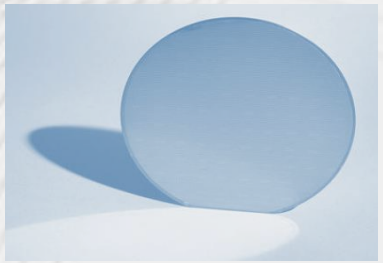
Measurements

- LIV, spectra, Far Fields, PER (20-90°C) of Single Mode and Multi Mode lasers on different heatsinks
- LIV, spectra, PER (0-90°C) of 14-pin BTF packaged lasers, SOA, SLD
- Reliability characterization of chip-on-carrier (20-90°C and 90-180°C ranges) and packaged lasers
- SOA gain spectra, gain saturation, noise figure, absorption spectra
- Investigation of nonlinear characteristics by four-wave mixing
- Hakki-Paoli method for gain, AR coating, parasitic back reflection
- laser mirror reflection
- Self-heterodyning method for optical linewidth
- DFB laser line stability with FP interferometer
- RIN and eye-diagram for DFB and for each line of Comb-laser
- Pulse lasers: Phase noise and timing jitter of Mode-lock lasers
- Pulse lasers: Gain-switch and Q-Switch lasers
- Autocorrelation function of light intensity
- Gain chip characterization in Littrow and Littman external cavity tunable laser configuration
- Monolithic tunable lasers (SG DBR and Coupled-Cavity lasers):
    - 2D and 3D wavelength, power, SMSR, Voltage maps
    - Gratings characterization: reflection amplitude and phase
    - Index modulation by carrier injection

Products & Applications

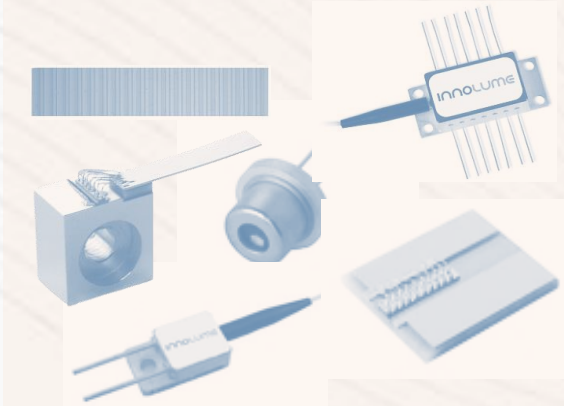
3-6” Epi Wafers

- GaAs/AlGaAs/InGaAs
- InAlGaAsP on GaAs
- InP /InAlGaAsP on InP
- AlInGaAsSb on GaSb (planned)



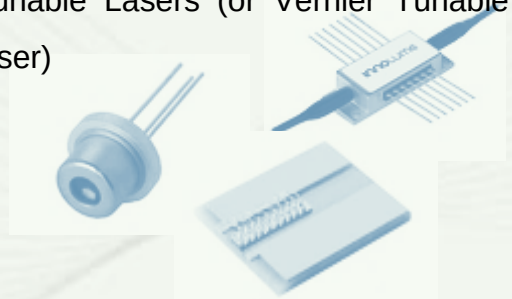
High Power Laser Diodes

- Open heatsink Broad Area Lasers
- Laser bars
- Single mode FP
- FBG stabilized Laser Diodes



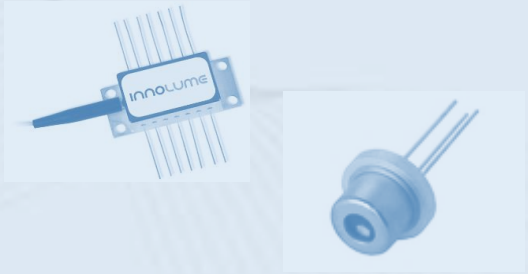
Broad Band products

- Gain Chips and Gain Modules
- SOA – Semiconductor Optical Amplifier chips and modules
- Superluminescent Diode (SLD, SLED)
- SG DBR – Sampled Grating DBR Tunable Lasers (or Vernier Tunable laser)



Single Frequency Lasers

- DFB Lasers
- DBR Lasers
- SG DBR – Sampled Grating Tunable Lasers (or Vernier Tunable laser)
- FBG stabilized External Cavity Laser Diode

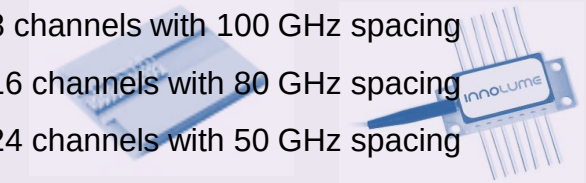


LEDs and VCSELs

- RCLED – Resonant Cavity LED
- Development service on VCSEL

Comb-laser

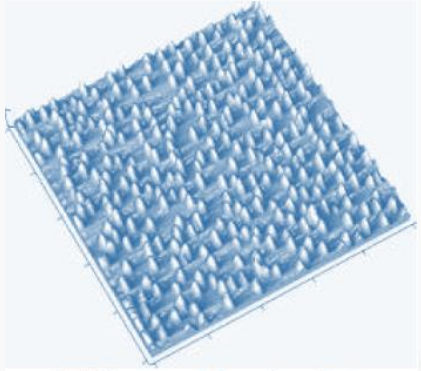
- 8 channels with 100 GHz spacing
- 16 channels with 80 GHz spacing
- 24 channels with 50 GHz spacing



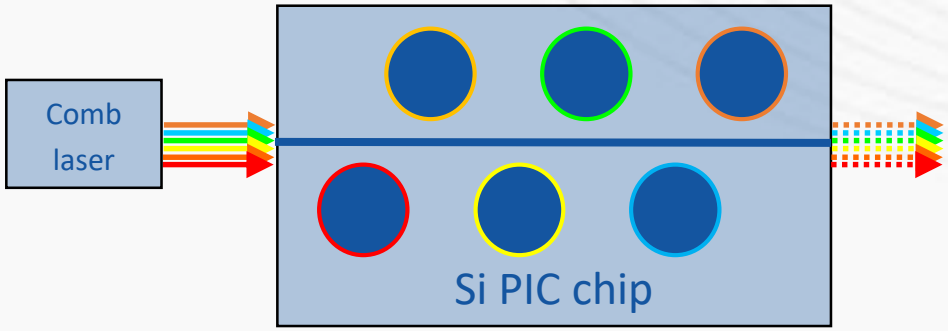
Key differentiation technology to competitors in GaAs - *Quantum Dots technology*

Leader in Quantum Dot laser technology

- Quantum dots are tiny 3D islands of 5÷15 nm size formed in-situ during epitaxial growth
- Fill the wavelength gap between <1100 nm (GaAS) and >1300nm (InP)
- Highest wall plug efficiency at elevated temperatures (>60°C) for 1.3 μm
- Extremely broad optical gain at high output power
- Excellent device reliability
- Phase mode locking for frequency comb laser



AFM image of Quantum Dots



COMB-laser based on Quantum Dot technology

- Addressing the wavelength range 760nm – 1320nm at high performance
- Broadband optical gain for multi-channel communication reducing energy consumption and footprint
- 8÷32 equidistant channels
- Single light source & single coupling point
- No need for MUX-DEMUX
- In-line modulation

Applications and Markets

Medical

- FBG stabilized Laser Diodes for Fluorescent Microscopy

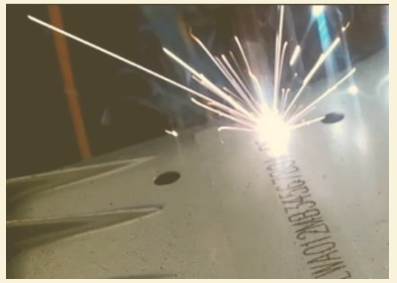
- SOA and SG DBR laser for OCT (Optical Coherence Tomography)

- RC LED chips for Pulse Oximetry

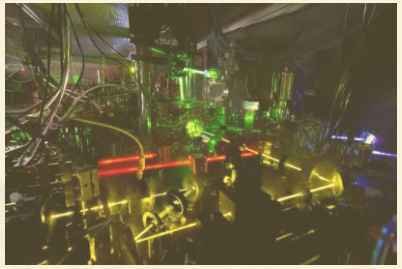
- High power lasers for tissue treatment

Industrial and Scientific

- FBG stabilized Laser Diodes for Laser Marking, Cutting and Welding



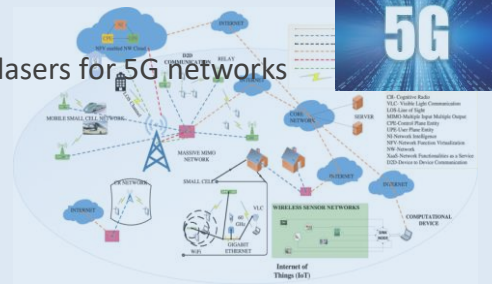
- DFB and tunable lasers for bio and physical research (Coherent sources, Atomic Clocking)



Datacom & Telecom

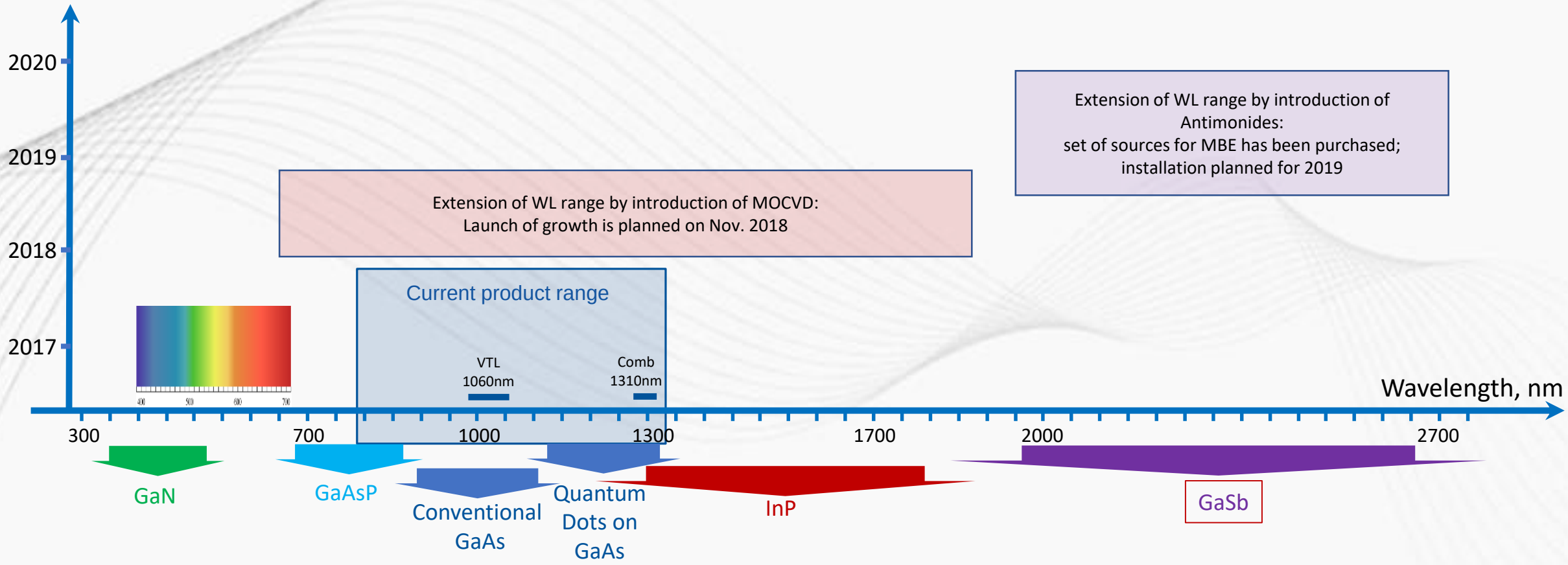
- Comb-laser for optical interconnect in Datacentres and High Performing Computers (HPC)

- Temperature insensitive lasers for 5G networks deployment



Projects in our pipeline

III-V semiconductors landscape



Extension of materials to InP- & GaSb-based systems will enable new design of laser products for novel applications