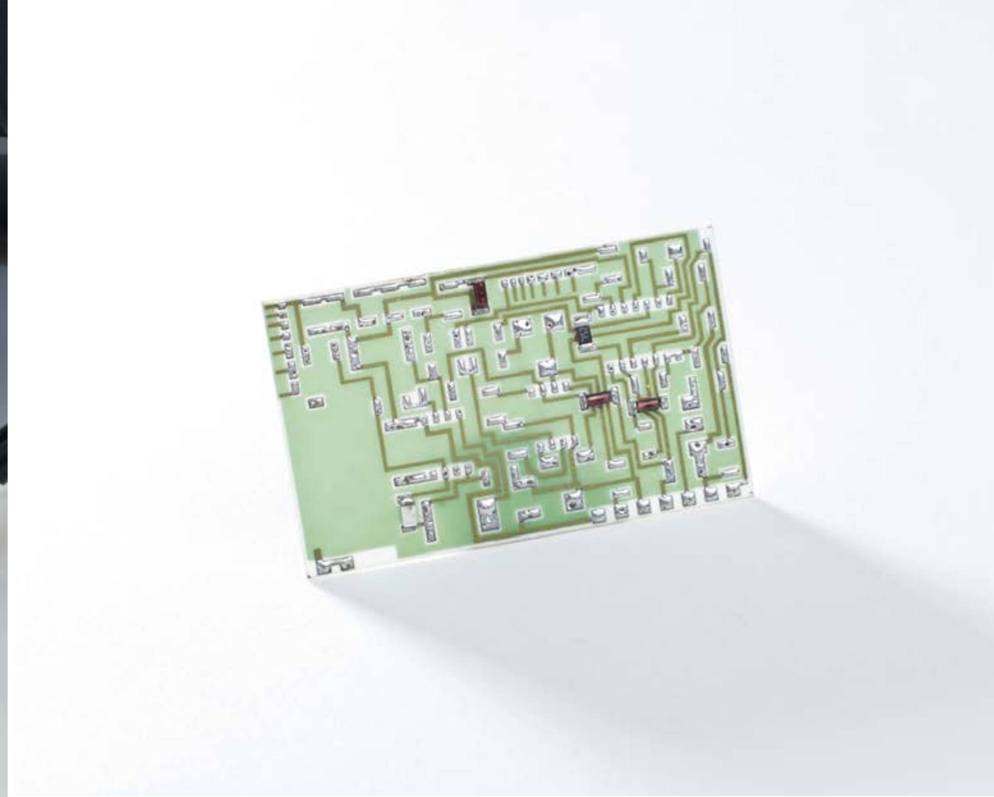
Institute of Electronic Materials Technology

ITME's technologies for security and defense industry

ITME



Material system for miniature low-loss passive circuits for military radiolocation and radiocommunication systems

Material system composed of silver or gold layers with surface resistances not worse than 10 mΩ at 3 microns on Al_2O_3 ceramic substrate.

- The system can be used to produce band pass filters, resonators, and band adapters up to 10 GHz.
- It is characterized by its ability to dissipate continuous power at 10 W per mm^2 conductor and work at temperatures up to 300°C for silver paths and up to 600°C for gold paths. We get a line/space resolution of 10 microns.
- The systems made in this technology occupy a surface 16 times smaller than the equivalent on PTFE substrates. Filters are an essential part of radio equipment, including radar stations, GPS receivers, GSM/UMTS/LTE broadcasting stations, microwave and power input and output impedance matching circuits for transmitter and receiver antennas.
- ITME has a long history of cooperation in this field with the Polish Armaments Group (BUMAR).

Material system for mounting microwave transistors

Materials and methods for mounting silver, copper or gold plated semiconductor structures to metallic or Ag, Au or Cu metallized heat dissipating components.

- The weld used is a paste containing a mixture of nanometric and submicron silver powders, which allows the thermocompression joint to reach a temperature of 250°C at pressures below 10 MPa.
- Joins show a shear strength of 20 MPa, electrical resistivity not worse than $9 * 10^{-8}$ Ω * m and thermal conductivity of at least 200 W/mK and stability at temperatures up to 300°C.
- The proposed materials are ideally suited for assembling unpackaged microwave transistor structures for ceramic, copper or aluminum substrates.

E-beam and Nano Imprint Litography

Mask Laboratory is able to provide leading edge technology solution for all areas of micro and nanolithography application, including microelectronics, photonics, integrated optics, microoptics and micromechanics. The Laboratory is equipped with a new e-beam pattern generator Vistec SB251. This advanced, professional, high productivity variable shaped e-beam lithography system ensures to write a high resolution pattern (better than 50 nm) over a large area (200x200 mm^2) with extremely dense addressing grid (1 nm). In addition to e-beam lithography, UV and hot embossing nano imprint lithography systems are used for binary pattern transfer and 3D structure replicating with a feature size even below 50 nm (e.g. multi-phase-level diffractive optical elements).

The Laboratory offers:

- DIRECT E-BEAM PATTERN WRITING on semiconductor and optical wafers (e.g. Si, Ge, GaAs, InP, SiC, quartz), substrate size Ø 50 to 150 mm (SEMI Standard), overlay accuracy better than 15 nm.

- CHROME PHOTOMASK and RETICLES for contact, proximity and projection photolithography, substrate size 4"x 4" to 7"x 7", address grid 1 nm, overlay accuracy (mask to mask) better than 5 nm.

- NANO IMPRINT TEMPLATES, WORKING STAMPS and REPLICAS – substrate size Ø 50 to 100 mm, min. line width (resolution) 50 nm.

- DIFFRACTIVE OPTICAL ELEMENTS: diffractive lenses and lens/microlens arrays (spherical, cylindrical, elliptical etc.), diffraction gratings, computer generated holograms. Among various kinds of micro-optical elements, diffractive optical elements are especially attractive because of their functional flexibilities in handling wave-front conversion as well as their planar, compact and lightweight nature which makes them suitable for integration with micro-electro-mechanical devices (MEMS, MOEMS). Their potential applications include optical systems for remote spectral imaging, free space optical communication, laser diode beam shaping, optical measurement systems (e.g. wave front sensors).

Innovative optoelectronic devices and highly specialized technological processes and services

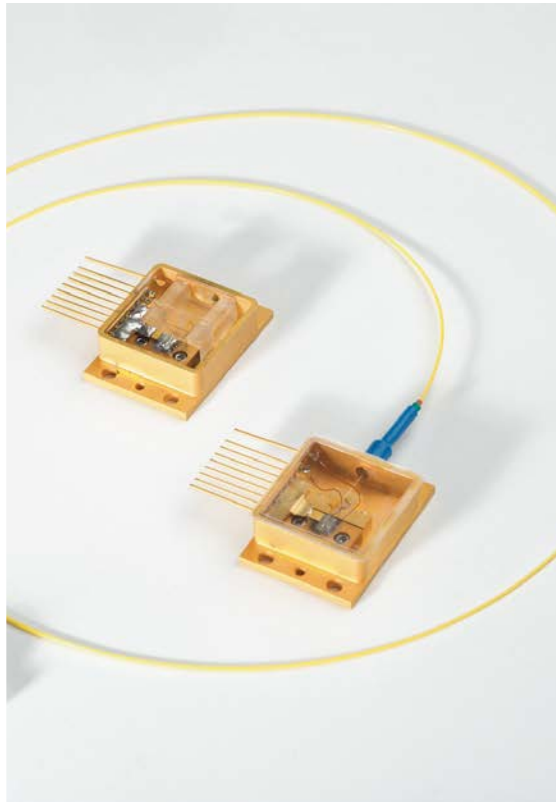
Semiconductor high power laser diodes and arrays with low beam divergence
- Emission in the range 0.63 - 0.8 - 1 - 2 µm, including uncommon wavelengths.
- Precision beam shaping using original diffractive optic solutions or light output by pigtailing.
- Metallic (broadband) laser diode rear mirrors coatings (patented).

Solid-state lasers:
- Application of innovative components developed at ITME: transparent laser ceramics, active glasses and single crystals, covering spectral range including 'eye safe' range 1,5 – 2,1 µm.
- Up-to-date ITME-made composite materials for efficient heat removal from electronics devices.
- Original solutions of microchannel coolers.

Laser driven high-power white light sources:
- High efficiency of light sources thanks to excellent optical and microstructural properties of Ce:YAG ceramics excited by diode laser emitting at 450 nm.
- Adjustable colorimetric coordinates (possible operation in transmission or reflection mode).

Piezoelectric devices and components:
- Resonators and surface acoustic wave (SAW) filters for specific communication purposes.

Highly specialized processes and technological services:
- Photolithography of electronics materials (1" - 6" diameter, non-typical shapes).
- Vacuum evaporation of metallic and dielectric layers (thicknesses from 1 nm to 5 µm, substrate diameters up to 8"), evaporation of amorphous and polycrystalline layers.
- Specialized, custom-tailored packaging of electronic devices and components, including:
  - precise packaging of SAW and optoelectronic devices,
  - structure encapsulation with various adhesives, pastes and metallic soldering components,
  - wire bonding using Al and Au,
  - precision grinding and polishing of electronic materials (glasses, silicon, quartz, ceramics, metal-ceramic composites, epoxy-ceramic and epoxy-metal, composites, SiC), single crystals, etc.,
  - laser processing of materials - engraving, marking.



Optical and electronic materials

Optical materials (for lasers, scintillators, nonlinear elements, Q-switches, substrates):

- Oxide crystals (YAG, YAP, GdCOB, SBN, YVO, MALO, NGO and other available on-demand) grown by the Czochralski method.
- Calcium fluoride and barium fluoride crystals grown by the Bridgman method.
- Novel eutectic composites, plasmonic materials and metamaterials grown by the micro-pulling down method.
- Other special optical materials of high purity.

Semiconductor materials:

- $A^{III}B^{V}$ compounds (GaAs, InAs, GaP, InP, GaSb) grown by the Czochralski method.
- Silicon carbide crystals (4H and 6H) grown by the PVT method.
- Topological insulators.
- Other special electronic materials of high purity.

Processing

- Quartz substrate.
- Silicon carbide boules and wafers.
- $A^{III}B^{V}$ crystal boules, wafers and elements.
- Optical elements made of oxide and fluoride crystals.

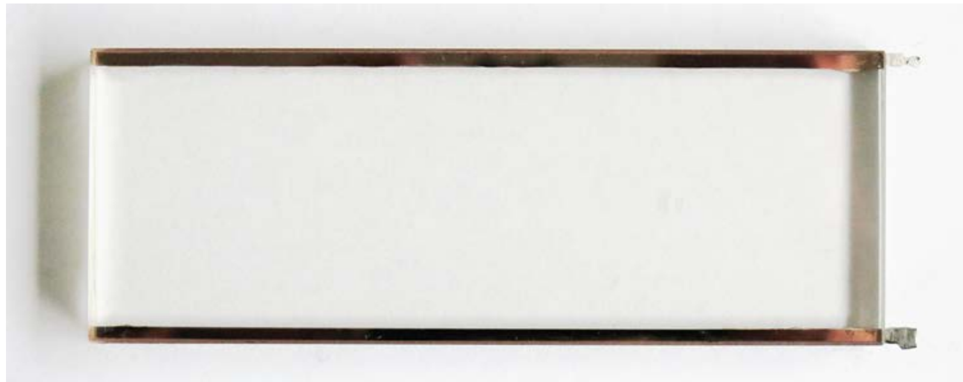
Characterization:

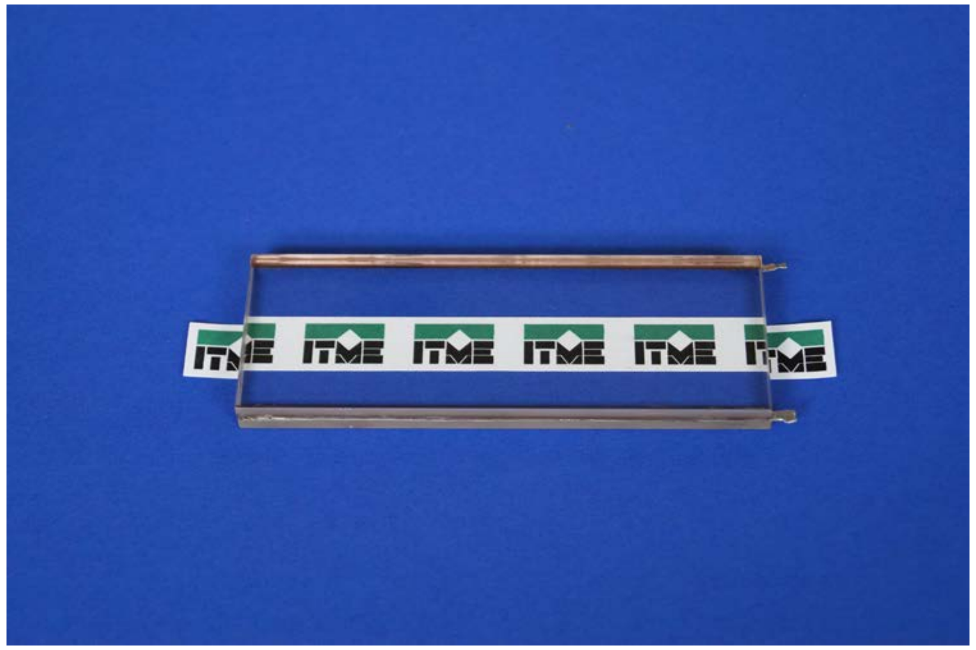
- Optical microscopy.
- Dilatometry.
- Simultaneous thermal analysis (differential calorimetry, differential thermal analysis, thermogravimetric analysis).
- Spectrophotometry.

Transparent glass window with integrated graphene electrical heater

Glass window with integrated graphene electrical heater introduced between two glass plates. Electrical contacts in form of metal stripes located at two opposite sides of the window.

- High transparency with homogeneous graphene light absorption about 2.5% all over the visible light spectrum.
- Electrical resistivity depending on window shape, for square window about 1 kΩ.
- Working temperature limit up to 100°C.
- Surface may be cleaned similarly to regular glass window.





Institute of Electronic Materials Technology

Founded in the early seventies of the twentieth century, the Institute of Electronic Materials Technology (ITME) with about 300 employees is a research, development and consultative institution offering a unique combination of scientific and technological capabilities.
The R&D activities of ITME include processing of advanced materials (e.g. graphene, semiconductor materials, mono-crystals, thick-film materials, glass and ceramic products, substrates for electronic systems, metal-ceramic composites: MMCs and FGMs, materials for opto-, piezo- and superconductor-electronics, etc.) and devices based on these materials. ITME produces high-quality large graphene sheets measuring up to 500 x 500 mm and graphene flakes (RGO).
ITME possesses technological equipment for the manufacture and supply of the wide range of materials and structures. The Institute offers development of both research and measurements methods. ITME provides its research and technological services to industries and other scientific institutions.

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