

ZnTe single crystal growth for broadband Terahertz applications

Single crystal ZnTe substrates are used for broadband THz generation and detection. THz are electromagnetic waves lying between microwave and infrared region which are invisible, non-invasive, non-ionizing and biologically safe and offer higher resolution than other safe wavelengths. In addition, the interaction of THz with various materials in terms of molecular vibrations and carrier dynamics bestows it with a unique ability to probe and provide material spectroscopic information which is beyond the limits of conventional systems. Moreover, THz transparency of most of non-metallic, plastic materials render its use in imaging of concealed items. Hence, wide range of possible THz applications in various fields, such as spectroscopy, imaging, sensing or scanning, quality control, wireless communication, and basic sciences have started burgeoning which has stimulated extensive research in different frontiers of THz worldwide. However, the realization of THz devices and systems is plagued by non-availability of efficient terahertz source and detectors. Amongst the various techniques for THz generation and detection; broadband THz generation using optical rectification of ultrafast laser pulses and THz detection using electro-optic sampling using non-linear crystals have been one the simplest yet fast and reliable technique used for broadband THz generation and detection. ZnTe owing to its high non-linear susceptibility, high electro-optic coefficient and low THz absorption is the most extensively used non-linear crystal material in various commercial THz systems for broadband THz generation and detection.

With the research on Terahertz burgeoning in both academia and industry in the country; the demand for high quality ZnTe substrates is expected to rise significantly in near future. Presently, ZnTe substrates for THz applications are not available within the country and are being imported at exorbitantly high cost by various users in country involved in THz research and development like TIFR, IITs, IISER, NISER, NPL and many other institutes of national importance. Typically, a 10 x 10 mm² (110) ZnTe substrate costs ~ 1800 € with the cost increasing exponentially both with the substrate size and thickness. Moreover, the cost of high resistivity ($\geq 10^4$ Ω-cm) (110) ZnTe substrates is still higher. Keeping the above points under consideration, SSPL has developed the complete single crystal growth and substrate fabrication facility for development of (110) oriented ZnTe substrates. Typical technological parameters/specifications of SSPL developed ZnTe substrates are:

Orientation	(110) \pm 0.25°
Size	10 x 10 mm ² both sides polished <i>(Up to 18x18 mm² substrate have been fabricated presently)</i>
Thickness	200 microns to 3 mm <i>(higher thickness also achievable)</i>
Resistivity	$\geq 10^5$ Ω-cm
THz generation/ detection range	0.1 to 3 THz <i>(Higher THz ranges possible with thinner ZnTe substrates)</i>

SSPL fabricated ZnTe substrates have been extensively tested for THz characteristics (THz transmission, THz detection and THz generation) at TIFR, Mumbai and NISER, Bhubaneswar and were found to perform exceptionally well in comparison to imported ZnTe substrates.

1. Interested companies/industries are requested to apply against this EoI to following address:-

To,

The Director

Solid State Physics Laboratory (SSPL)

Lucknow Road, Timarpur, Delhi – 110054

Phone No: 011-23903499

Fax No: 011-23913609, 23903499

Email ID: director.sspl@gov.in

2. A copy of interest may be sent to the following address without any attachment:-

Copy to:-

The Director

Directorate Industry Interface and Technology Management (DIITM)

Room No 447, DRDO Bhawan, DRDO HQrs, Rajaji Marg, New Delhi – 110011

Phone No: 01123013209/23015291

Fax No: 011-23793008

Email ID: diitm.hqr@gov.in

List of Support documents to be attached with EoI

- (a) Memorandum and Articles of Association (Should be incorporated as per Indian Companies Act, as amended time to time)
- (b) Certificates of registration as a manufacturing unit, if any.
- (c) Audited Balance Sheet for the preceding three years.
- (d) Income Tax returns for the preceding three year period
- (e) Details of shareholding/ownership pattern especially foreign partners/ shareholders, foreign employees, directors, etc. The company must adhere to the prevailing Govt of India policies and regulations on Foreign Direct Investment (FDI)/DIPP norms as applicable.
- (f) Annual budget for R&D during last three years.
- (g) Numbers and details of IPR or patents, etc., held by the company.
- (h) Number of technically or professionally qualified personnel.

- (i) Record of past performance (e.g., Supply orders executed against of Ministry of Defence orders, Public Sectors and Paramilitary Forces, if any).
- (j) Availability of adequate infrastructure (List of machines and their production capacities) and technical expertise.
- (k) List of Testing and Support equipment's
- (l) ISO/ ISI certification or any other certification
- (m) Relevant clearances form the authorities/ ministries (if any)
- (n) Capacity and capability to undertake developmental work and to accept attendant financial and commercial risks.
- (o) Capacity/capability to market the product through the marketing network, sales and service network, reliability to maintain confidentiality.
- (p) PESO and DPIIT license for explosive handling if ToT is for high energy Material, explosives, propellants, and component/ system dealing with it etc.
- (q) Under taking form company seeking ToT that none of its Directors, Independent Directors, non-executive Directors, Key management personnel are involved in any corrupt practices, unfair means and illegal activities.
- (r) Details of the industrials license for defence manufacturing be provided by the industry seeking ToTs.