

## **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, noninvasive, 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 nonmetallic, 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 mm<sup>2</sup> (110) ZnTe substrate costs ~ 1800 € with the cost increasing exponentially both with the substrate size and thickness. Moreover, the cost of high resistivity ( $\geq 10^4 \Omega\text{-cm}$ ) (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) $\pm 0.25^\circ$
Size	10 x 10 mm <sup>2</sup> both sides polished (Up to 18x18 mm <sup>2</sup> substrate have been fabricated presently)
Thickness	200 microns to 3 mm (higher thickness also achievable)

Resistivity	$\geq 10^5 \Omega\text{-cm}$
THz generation/ detection range	0.1 to 3 THz (Higher THz ranges possible with thinner ZnTe substrates)

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.

Interested industries are requested to submit their financial bid in sealed envelope, along with relevant documents as per the list in appendix-A, through one of the following agencies only, to DRDO before the bid ending date:-

S. No	Name of the Agency	Point of Contact
1	<b>National Research Development Corporation</b> Address :20-22, Zamroodhpur Community Centre, Kailash Colony Extn. New Delhi - 110048  Tel : +91-11-29240401 to 29240407 Fax: +91-11-29240409 / 29240410 General E-mail : write2[at]nrdc[dot]in	Shri Rajendra Gondane Sr. Manager (Business Development) National Research Development Corporation 20-22, Zamroodhpur Community Centre, Kailash Colony Extn. New Delhi - 110048 INDIA Mobile : +91-9910496554 EPABX : +91-11-29240401-07 (Extn. 444) Fax : +91-11-29240409 -10 Email : rgondane[at]nrdc[dot]in Website : www[dot]nrdcindia[dot]com
2	<b>PHD Chamber of Commerce and Industry</b> Address: PHD House, 4/2 Siri Institutional Area, August Kranti Marg, New Delhi 110016  Tel : 91-11-26863801-04, 49545454 Fax : 91-11-26855450, 49545451 Website : <a href="http://www.phdcci.in">www.phdcci.in</a> E-mail : phdcci[at]phdcci[dot]in	Shri Nasir Jamal Joint Secretary PHD Chamber of Commerce & Industry Address: PHD House, 4/2 Siri Institutional Area, August Kranti Marg, New Delhi 110016 INDIA  Mobile : +91-9810185714, 8210343267 Phone : +91-11-49545454, 49545400 Extn : 279 Fax : +91-11-26855450

- 3 **Confederation of Indian Industry (CII)**  
Address: The Mantosh Sondhi Centre  
23, Institutional Area,  
Lodi Road, New Delhi - 110 003  
(India)
- Tel : 91 11 45771000 / 24629994-7  
Fax : 91 11 24626149  
E-Mail : [info\[at\]cii\[dot\]in](mailto:info[at]cii[dot]in)  
Website : [www.cii.in](http://www.cii.in)
- Shri Amit Kumar  
Deputy Director – Defence & Aerospace  
Society of Indian Defence Manufacturers (SIDM)  
C/o Confederation of Indian Industry (CII)  
Address: 3rd Floor, IGSSS, 28 Institutional  
Area, Lodhi Road, New Delhi – 110003  
INDIA  
Mobile : +91-9990059163  
Phone : +91-11-45772062  
Fax : +91-11-45772022  
Email : [amit\[dot\]kumar\[at\]cii\[dot\]in](mailto:amit[dot]kumar[at]cii[dot]in)  
Website : [www.sidm.in](http://www.sidm.in)
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- 4 **The Associated Chambers of Commerce and Industry of India (ASSOCHAM)**  
4th Floor, YMCA Cultural Centre and  
Library Building,  
01, Jai Singh Road, New Delhi -  
110001
- Phone: 46550555 (Hunting Line)  
Fax: 01123347008/9  
Website : [www\[dot\]assocham\[dot\]org](http://www[dot]assocham[dot]org)
- Ms Kavita Sharma  
Addl Director and Head - Energy and Infra  
Mobile : 09871801002  
Tele: 0091-11-23347040  
Email:  
[kavita\[dot\]sharma\[at\]assocham\[dot\]com](mailto:kavita[dot]sharma[at]assocham[dot]com)  
Website : [www.assocham.org](http://www.assocham.org)
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## **PART-1**

### **General Information**

(Please enclose documents in support of information provided)

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1. **Name of the Technology requested for Technology Transfer (Technology name and concerned Lab, Category)**

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2. **Name of the industry/ organization**

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3. **Complete Address and other details**

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#### **Registered Office**

State  
Phone No  
Fax  
Email  
Website

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#### **Factory**

State  
Phone No  
Fax  
Email  
Website

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4.	<b>Point of Contact</b> Name Designation Address Mobile No Ph No Email ID
5.	<b>NAME OF CMD/ MD /PARTNERS/ PROPRIETOR/ etc</b> Name Designation Address Mobile No Ph No Email ID
6.	<b>Date of Incorporation of company</b>
7.	<b>Foreign Direct Investment in company (if any in %)</b>
8.	<b>Shareholding pattern</b>
9.	<b>Turn over as per Audited Balance Sheet for the preceding three years.</b> Year Year Year
10.	<b>Annual budget for R&amp;D during last three years (if any)</b> Year Year Year
11.	<b>Income Tax returns for the preceding three years period</b> Year _____ Year _____ Year _____
12.	<b>Nature of company</b> DPSU, Private Limited, Public Limited, Partnership, Proprietary, Ex- Serviceman Unit
13.	<b>Category of industry</b> Large Scale, Medium Scale, Small Scale, Micro, Startup
14.	<b>MSME Registration No</b>
15.	<b>Certificates of registration as a manufacturing unit, if any.</b>
16.	<b>If Startup, DPIIT Registration No</b>
17.	<b>UDYOG AADHAR No</b>
18.	<b>PAN Number</b>
19.	<b>Details of Industrial license for defence manufacturing issued by DPIIT (if any)</b>

20.	<b>Details of PESO license (if any)</b>
21.	<b>GST Number</b>
22.	<b>Nature of business</b> Manufacturing/ Sole Selling or Authorized Agent/ Assembler/ Traders/ Dealer/ Processor/ Repacker/ Others
23.	<b>Details of current products and services</b> Products and services Supplied (please specify Govt/ Domestic market/ Export)
24.	<b>Record of past performance</b> (e.g., Supply orders executed against of Ministry of Defence orders, Public Sectors and Paramilitary Forces, if any).
25.	<b>Details of registration with</b> NSIC / SSI, DGS&D, other Defence Department, other Govt. Dept, membership of FICCI/ASSOCHAM/CII or other Industrial Association <b>(Attach relevant copies of registration letters)</b>
26.	<b>Have you already taken any technology from DRDO</b> (If yes, give details attaching separate sheet)  Name of the Technology, Lab, Year, License number & Status
27.	<b>ISO/ ISI certification or any other certification</b> (If yes, give details)
28.	<b>Relevant clearances form the authorities/ ministries</b> (if any)
29.	<b>Capacity and capability to undertake developmental work and to accept attendant financial and commercial risks.</b>
30.	<b>Capacity/capability to market the product through the marketing network, sales and service network, reliability to maintain confidentiality.</b>

## **PART-2**

### **Infrastructure and other Information**

1.	<b>Total area of factory</b> Covered (m <sup>2</sup> ), Uncovered (m <sup>2</sup> ), Bonded space available (m <sup>2</sup> )
2.	<b>Ownership of factory</b> Self-owned, partnership, rental
3.	<b>Electric power</b> Sanctioned

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Installed
Standby (if any)

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**4. Availability of adequate infrastructure**  
(List of machines and their production capacities)  
and technical expertise

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**5. Name of bank & A/c No Name of bank**  
A/c type  
A/c no  
Address of the bank  
Phone:  
Email:

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**6. Details of current products:**

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S.No	Type	Description	Licensed/installed capacity	Annual production for preceding 3 years

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**7. Details of foreign collaboration, if any**

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S.No	Product	Name and address of collaborator	Year	Remarks

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**8. Details of products developed for services**

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S.No	Nomenclature of stores	Order No. and date	Remarks

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**9. Please give details of important facilities & infrastructure as per following format for:**

- (a) Production
- (b) Unconventional, special m/c
- (c) Testing & quality control facilities

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S.No	Description of m/c	Make & model	Qty	Date of purchase	Remarks

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**10. Furnish the following details with relevant certificates and documents**

- (a) R&D facilities available :  
(b) Inspection quality control of raw material components :  
(c) Assistance from central agency for testing / calibration etc. :  
(d) laboratory and drawing office facility :

**11. Principal customers:**

S. No	Name & address	S.O No and date	Date of last supply	Products suppliedhttp s://xdt.drdo.i n	Value

**12. Future plans (if any) in respect of expansion programme/ installation of additional machines/ test facilities etc.****13. Name of the technology requested for transfer**

· (give self-assessment of your capability to absorb the technology)

**14. Details of employee as on date on firm's pay roll****PERMANENT**

Category	Post Held	Number	Qualificatio n	Total Service
Technical	Prod. Manager Q.C. Manager Supervisor Testing Staff (QC) Skilled workers Unskilled workers, etc			
Administrative	Purchase Manager Accounts Officer Office Superintendent Clerical Others, etc			

**TEMPORARY**

Category	Post Held	Number	Qualificatio n	Total Service
Technical	Prod. Manager Q.C. Manager Supervisor Testing Staff (QC) Skilled workers Unskilled workers, etc			
Administrative	Purchase Manager Accounts Officer Office			



	Superintendent
	Clerical
	Others, etc

**DECLARATION :**

I / we confirm that the information furnished in Part 1 & 2 above is correct. In the event of any information given by me / us is found incorrect / false at any time, I / we understand our EoI for ToT will be cancelled/ rejected without notice, beside any other appropriate action against me / us.

Industry seal  
Name(s) in capital  
Designation and seal of authorized signatory

Date:

Place:

**Appendix-A**

**List of Supporting Documents to be Attached / Enclosed**

- (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.