



Kanpur

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Enquiry no. PHY/SAR/14FEB2013/NCON-1

Sealed quotations are invited and should reach the undersigned latest by the 07<sup>th</sup> of March, 2012, for: **Sub-nanosecond laser based 3-D micro-/nano-fabrication system by two-photon processes.**

The system can be divided into the laser system and the structuring system. The laser beam when focussed through a microscope objective will provide sufficient intensity at the focus to cause two photon polymerization or deposition processes when aided by photo-initiators. Quotations may be made for the whole system (preferable) or for one of the two parts while giving provision to couple the laser beam to the structuring system with a free beam coupler. Note that costs of packing, freight, insurance and banking charges will be taken into account for awarding the purchase order.

#### Specifications:

##### A) Laser system:

The laser will generally be a Diode Pumped Solid State Laser whose output can be coupled into a free beam coupler or optical fibre.

1. Wavelength: 532 nm and 1064 nm (Both are needed from the same or different lasers)
2. Pulse width: FWHM 300 picoseconds or lesser **only** (Q-switched or mode-locked lasers)
3. Pulse energy: variable from 1 microJoule to 100 microjoule (use single or multiple lasers to cover the range / use attenuators)
4. Pulse energy stability: < 3% pulse to pulse energy fluctuations
5. Pulse repetition frequency: Any in the range 1 kHz to 20 kHz
6. Pulse timing jitter: < 2% of interpulse separation.
7. Polarization: Any
8. Laser beam mode structure: TEM<sub>00</sub> or close to Gaussian with ( $M^2 < 1.3$ )

9. Beam Divergence: < 3 mrad
10. Beam size: 2 to 5 mm
11. Cooling: Air cooled or water cooled

- Should be inclusive of Power supply and laser controller.
- Should be possible to trigger the laser pulses from an external TTL pulse / trigger with a specified time delay.
- Should be possible to control the laser system(s) with an interfaced computer (PC / laptop).
- System should have a TTL output for synchronizing / triggering other electronic systems.
- It will be preferred if it will be also possible to have single shot pulse operation or run the laser a low pulse repetition rate of 1 Hz or so.
- Requirements (9) and (10) above are relaxable for a well known product with other default values provided the laser beam can be coupled with good efficiency into the microscope.

## B) Structuring system

The structuring system will consist of the coupler through where the laser beam is coupled in, and a nanostage capable of x, y and z motion and mounted on an inverted microscope.

The laser beam will be focussed via the optical objectives of the microscope for producing the focus within a solution of the monomers / depositing material and will produce the polymerization / deposition at the focus in the presence of photo-initiators at sufficient light intensity.

The structuring system will provide for the following:

1. Computer controlled nanoscale motion of the sample to vary the location of the laser beam spot within the sample solution using piezo scanners
2. Controllable motion on three axis: X, Y, and Z motion
3. Scan range: 200 micrometer (X), 200 micrometers (Y) and 200 micrometers (Z).
4. Scan speed: 0.5 mm/s linear or better, and 50  $\mu\text{m}^3/\text{s}$  for 3-dimensional structuring or better
5. Positioning accuracy of the nanostage: 20 nm or better on each axis
6. Piezo bi-directional repeatability: 50 nm or better
7. Resonant frequency of the piezo nanostage: 350 - 400 Hz.
8. Piezo scanning controller: Complete with programmable motion controller with closed loop operation
9. Feedback transducer type / detection : Strain gauge / AC bridge
10. Resolution of Piezo-stage: 5nm when used in closed loop mode
11. Thermal stability of nanostage: 1 micrometer / centigrade approx.
12. Load Capacity of nanostage: 1 kg (Max)

- Should be possible to program a computer to control the nanostage for complex motions so

- that any three dimensional structure can be built by this process.
- Programs for all elementary motions should be available and a few computer programs for making a few templates should be made available.
  - Sufficient amount of photo-polymerizable material or other depositing material along with photocatalyst / photoinitiators should be supplied
  - Minimum resolution of features produced by photopolymerization or other process: 200nm
  - Supplier will be responsible for demonstrating the minimum resolution specified above.

Other mechanisms producing equivalent motion / control / resolution in case of points (6) and (8) above will be considered.

The inverted microscope (probably Olympus GX51) will be separately provided and should not be quoted for with this system. The supplier will be responsible for integrating their nanostage systems with the microscope. If specifically a different microscope is needed, it should be stated so in your technical bid. The microscope will be placed on an actively vibration isolated table / floating optical table that will be available in the laboratory at IIT Kanpur.

#### **Important essential points:**

The specified numbers for various parameters above are guidelines and can vary for the quoted systems by utmost 10% from those specified here.

Quote should be made in two parts: Technical bid and Financial bid separately in sealed envelopes. Financial bids for products whose technical bid is not acceptable will not be opened. Any quote where the financial bid is included in the technical bid will be summarily rejected.

Any technical bid wherein only the above specified points are copied and no details about the supplier's own system are given will be summarily rejected. The supplier should necessarily give all the specifications of their own system along with pictures and technical literature about their demonstrated system as well as fabricated structures from their system.

The sealed envelopes with the quotes should be superscribed with the Inquiry number and whether it is a technical or financial bid.

If the product is proprietary, a proper certification to that effect must be made by the Principals.

Agency authorization certificate from the Principals should accompany the technical bid.

Firms submitting acceptable technical bids will be invited to make a technical

presentation on the product to the Purchase committee before opening of the financial bids. The committee may choose to reject the bids of firms not making the presentation at its discretion.

Quotes should be made with options for the following delivery modes

- ✓ Ex-works for pickup by our world-wide transport provider
- ✓ FOB in country of origin
- ✓ CIF, New Delhi
- ✓ For delivery to IIT Kanpur

Maximum educational discounts should be applied - apart from research, this equipment will be used to teach and train students.

Quotes should have a minimum validity of 60 days

Address the quotations to

Prof. S. Anantha Ramakrishna  
Department of Physics  
Indian Institute of Technology Kanpur  
Kanpur - 208016 India.

so as to reach before the last date, i.e., 7<sup>th</sup> March 2013

Sincerely  
S. Anantha Ramakrishna