

**Name of Institution:** Siddhaganga Institute of Technology, Tumkur

**Name of the CoE:** Center of Excellence in Nanotechnology

**Date of Review Meeting:** 5<sup>th</sup> June 2014

**Names of Review Committee members:** (i) Prof. Ashutosh Sharma, IIT Kanpur,  
(ii) Prof. Ch. Subrahmanyam, IIT Hyderabad,  
(iii) Prof. Raman S. Srinivasa , IIT Bombay, and  
(iv) Prof. Sumeer K. Nath, IIT Roorkee.

The summary of the observations of the Review Committee members is as below:

- **Comments**
  - Organization is spending money to build the required infrastructure of the project.
  - Very few PhD and MTech students are available for the project
  - Not all faculty members have background in the theme area i.e nanotechnology
  
- **Achievements:**
  - Building of Infrastructure of the Project is in progress
  - Efforts to recruit PhD students are underway.
  - MTech students and staff have been recruited.
  
- **Good Practices**
  - New MTech programme under CoE in Nano-Technology has been designed and will be implemented soon.

- **Key Issues/Concerns**
  - Need to define project taking into account their strength, their collaboration and infrastructure.
  
- **Recommendations:**
  - Need aggressively recruitment of PhD and MTech students and faculty with appropriate background.

Response on the key concerns and recommendations by way of an **“Action Plan”** on (i) resolving the issues and concerns raised and (ii) the implementation of the recommendation(s)

**Key Issues/Concerns:**

- Need to define the project, taking into account their strength, their collaboration, and infrastructure.

**Resolution:**

**SIT’s CoE in Nanotechnology:** This CoE is located within SIT’s institute-wide R&D center established in 2007 (named “Center of Applied Research and nano-Technology”). This R&D center has full-time qualified faculty and staff, laboratory facility and infrastructure suitable for advanced R&D in engineering and nanotechnology, and a network of external academic and industry collaborators. An M. Tech. program in nanotechnology is now being commenced within the CoE missions. There are five aspects to this CoE project, and these are summarized below.

1. **Supporting SIT’s faculty and students:** SIT’s CoE supports the science, technology, engineering, and math departments by facilitating the involvement of the faculty in its academic and nanotechnology R&D programs. These programs, being highly interdisciplinary, are of great value to SIT’s each science or engineering department. SIT’s faculty are getting exposed to best practices and international benchmarking such as in research proposal development, securing funds and carrying out basic science research plus engineering R&D, advancing collaborative research with industries as well as other

academic institutions, effective teaching-learning methods and processes, and industry-relevant, upto-date curriculum development.

2. **Shared learning:** Through the CoE's weekly colloquium, periodic workshops, and conferences, SIT's faculty members are imparted subject matter expertise in science and engineering domains. The CoE faculty and staff are actively disseminating student project ideas and processes through the individual departments, thus adding value to SIT's undergraduate students. As the CoE's R&D projects pick up, undergraduate students will be given opportunities to work in the CoE as interns and project assistants, along with involving greater number of SIT faculty members.
3. **Offering guidance:** The CoE faculty and staff are developing academic and research program standards, methodologies, and systems (including tools and expertise). The R&D projects and upcoming nanotechnology M. Tech. program are experiments in this direction of overarching quality improvement. These standards, methods, and systems will be imparted to the SIT faculty so as to transform each academic department to ones in research universities. These exchanges are enabled by affiliating CoE's full-time faculty with the academic departments (such as ECE, Telecommunication Engineering, Mechanical Engineering, Chemical Engineering, Biotechnology, and the science/math departments).
4. **Output metrics:** CoE's delivery of values to SIT will be annually assessed through metrics such as of academic quality improvement in individual departments, increased research output (number of quality PhDs and publications) and external funding of research in the CoE as well as in the 14 departmental research centers, and timely placement of the M. Tech. (nanotechnology) graduates.
5. **Efficient governance:** The CoE's research labs and infrastructure are carefully being built up such that this institute-wide center will undertake academic and research activities that are valuable for SIT's engineering departments in a multiplicative manner. With CoE's faculty affiliated to some of these departments, coordination across SIT's interests will be steadily and organically enhanced so that the CoE's use/value spreads institute-wide.

On the technical front, the CoE's project is defined through the R&D projects being pursued. A number of projects were outlined in the CoE proposal submitted to TEQIP. Among these, CoE's current thrust is in the following four R&D projects that address the nationally critical problems in energy and infrastructure:

1. One of the R&D thrusts in the CoE is to develop indigenous equipment/process technologies and demonstrate high-efficiency (> 35%) concentrator photovoltaic (CPV)

solution for satellite and terrestrial power generation. This is a mature technology in US, Europe, and Japan. With no foothold in India, ISRO is currently importing these PV cells (annually spending Rs. two crore). We have developed the laboratory infrastructure and tools towards its import substitution. 2-junction, 3-junction, and 4-junction cells with tunnel diode interconnects have been designed, simulated, and optimized using TCAD. An MOCVD tool for the growth of these multi-layer structures has been designed and it is now being machined (expected installation and commissioning is by December 2014). The proposal preparation work is nearing completion and it will be submitted to DIT within couple of months. Materials, device fabrication, and testing will be undertaken in the CoE, thermal modeling and concentrator assembly design will be carried out by SDMIT collaborators, and the concentrator assembly itself will be developed by the industry collaborator (Anu Solar Power, Banagalore). Academic departments that will be enhanced: Electronics and Communication Engineering, Electrical Engineering, Instrumentation Engineering, and Mechanical Engineering, Physics, and Chemistry. The anticipated duration of this R&D project is 2014-18.

2. A second R&D thrust is to develop the front end technology of GaN based high-power (> 50 W) trans-receiver (T-R) modules for C band communication applications. We are aiming to submit this 3-year project proposal to CABS/DRDO by September 2014. In this proposed project, GaN based HEMT and HBT structures will be grown by the bottom-up MOCVD process and 0.1  $\mu\text{m}$  T-gate HEMT fabrication process will be developed at the CoE for the low-noise receivers and high-power amplifiers. Reducing the dislocation density in the epitaxial layers, achieving an effective p-doping process, and demonstrating the high-quality hetero-structure devices are the unsolved R&D problems that will be addressed. T-R module's MMIC design and modeling will be carried out by SDMIT collaborators. Technology insertion and evaluation will be undertaken by the industry collaborator (DRDO/CABS). Academic departments that will be enhanced: Electronics and Communication Engineering, Telecommunication Engineering, Instrumentation Engineering, Mechanical Engineering, Mathematics, and Physics.
3. A third R&D thrust is to develop low-cost and affordable nano-composite compressed earth blocks as structural materials for rural and urban residential housing. This will involve understanding the nano level processes in mixing and compressing the material components (soil, clay, gravel, soda lime, and nano cellulose), developing speedy, reliable, and reproducible nano-CCEB making process, and demonstrating its application for affordable housing. We are aiming to complete this project's proposal development by December 2014. Materials synthesis and characterizations will be carried out at the CoE, mechanical and life testing will be carried out by SDMIT

collaborators, field trials will be undertaken by the industry collaborator (Auroville Earth Institute). Academic departments that will be enhanced: Civil Engineering, Mechanical Engineering, Chemical Engineering, Electronics and Communication Engineering, Electrical Engineering, Physics, and Chemistry.

4. Our fourth R&D thrust is to develop processes to synthesize high purity chemicals that are very much needed for carrying out advanced technology R&D and to develop nanotechnology based products. Synthesizing electronic grade trimethylgallium and developing its kg-size batch production method will be of great value to country's compound semiconductor R&D efforts (now mainly being pursued within the DRDO labs). This synthesis and material characterization will be carried out at the CoE in collaboration with DRDO. Academic departments that will be enhanced: Chemistry, Chemical Engineering, Instrumentation Engineering, Electronics and Communication Engineering, Mechanical Engineering, and Physics.

**Recommendations:**

- Need aggressive recruitment of PhD and MTech students and faculty with appropriate background.

**Resolution:**

- PhD recruitment – in process – plan to recruit 5-10 PhD students by December 2014.
- M. Tech. student recruitment – in process (through the university's counseling and selection process); classes are scheduled to commence by 1<sup>st</sup> September 2014.
- Faculty recruitment – in process, received a few resumes, but not of matching qualifications.