Project Name: Development of Tunable Self-Powered Quantum Dot Based Photodetectors Using Low-Cost Solution Processed Method

Principal Investigator: Dr. Hemant Kumar (Assistant Professor Sr. Grade, ECE, JIIT-128)

Funding Agency: Science and Engineering Research Board (SERB)

Scheme: Start-up Research Grant

Approved Fund: 30.36 Lakhs

Received Fund: ~25 Lakhs

Lab Development:

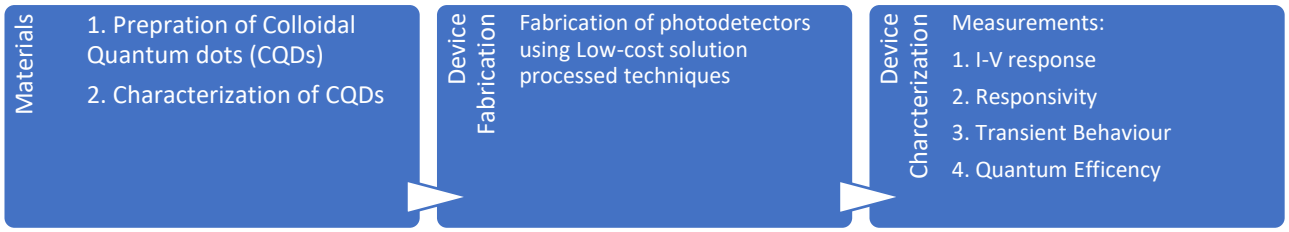
1. Chemical Lab in JIIT-128
2. Device Characterization Lab in JIIT-128

Project Idea:

The traditional photodiodes usually work in the reverse bias region and require an external electric field to operate [1]. These conditions limit the use of photodiodes and the best possible alternative for that is self-powered photodiodes. The self-powered photodiodes mostly work with either photovoltaic short-circuit or open-circuit mode [2]. Inorganic based self-powered photodetectors are lucrative as they provide high mobility and high absorption coefficient [3]. The major drawback of inorganic material based self-powered photodetectors is high-temperature preparation [4], [5]. High-temperature processing consumes a lot of power and defeats the purpose of self-powered photodetectors.
This project tries to address following points:

1. Preparation of inorganic colloidal quantum dots at low temperatures.
2. Prepared materials are used multiple times for device fabrication using Low-cost solution processed techniques.
3. Fabricate self-powered photodetectors, sufficient to provide interrupts to any available microcontrollers/ microprocessors.

Project Flow:



Research Lab Development:

1. Thermal evaporation unit (approx. cost 12.5 Lakhs)
2. I-V analyzer (approx. cost 4.5 Lakhs)
3. Digital Multimeter (approx. cost 2.5 Lakhs)
4. Centrifuge and Hot plate (approx. cost 0.8 Lakhs)

References:

[1] G. Rawat, D. Somvanshi, H. Kumar, Y. Kumar, C. Kumar, and S. Jit, "Ultraviolet Detection Properties of p-Si/n-TiO2 Heterojunction Photodiodes Grown by Electron-Beam Evaporation and Sol-Gel Methods: A Comparative Study," *IEEE Trans. Nanotechnol.*, vol. 15, no. 2, pp. 193–200, 2016.

[2] H. Kumar *et al.*, "Electrical and Optical Characteristics of Self- Powered Colloidal CdSe Quantum Dot-Based Photodiode," *IEEE J. Quantum Electron.*, vol. 53, no. 3, pp. 4400108:1–8, Jun. 2017.

[3] G. Rawat, D. Somvanshi, Y. Kumar, H. Kumar, C. Kumar, and S. Jit, "Electrical and Ultraviolet-A Detection Properties of E-Beam Evaporated n-TiO2 Capped p-Si Nanowires Heterojunction Photodiodes," *IEEE Trans. Nanotechnol.*, vol. 16, no. 1, pp. 49–57, 2017.

[4] Z. Gao *et al.*, "Self-powered flexible and transparent photovoltaic detectors based on CdSe nanobelt/graphene Schottky junctions.," *Nanoscale*, vol. 5, no. May 2013, pp. 5576–5581, 2013.

[5] W. F. Jin *et al.*, "Self-powered high performance photodetectors based on CdSe nanobelt/graphene Schottky junctions," *J. Mater. Chem.*, vol. 22, no. 7, pp. 2863–2867, 2012.