APPENDIX-I

6.1.3.1 Device Fabrication

(a) PbS/PVA QD devices:

The steps we have adopted in the fabrication of the devices are as follows: At first, one piece of ITO is cut into two halves. We measure the resistance of the two pieces of ITOs on both sides. The one side where the only glass portion is there will show high resistance (of the order of MΩ) and the other side where ITO is coated will show a negligible resistance (0.2, 0.3, 0.7…ΚΩ). Leaving about 5mm of ITO coated portion of the glass plate the other portion is tied with scotch tape. Now they are placed on a petri plate with the ITO coated side at the top. To etch the uncovered portion we follow the following steps:

(i) A beaker is filled with 50 ml of millipore water. To it, 50 ml of 35% concentrated HCl is poured slowly, and the mixture after it becomes stable is then stored in a glass bottle.

(ii) Zinc dust (<10μ, 98+%) is required for etching. The Zn dust is spread uniformly over the uncovered ITO coated glass portion.

(iii) The acid mixture [(step (i)] is then poured on the petri plate very slowly and steadily so that the Zn dusts react with the acid. After about a minute or so, the petri plate is taken under tap water and the ITO coated glass pieces are washed.

(iv) After they are completely dried, the scotch tape is removed and the resistance is again checked to confirm the etching.
After the above etching process, the ITO coated glass plates are to be cleaned by the following steps:

(i) The etched ITO coated glass plates are placed inside a cleaned beaker which is then half filled with millipore water and a small amount of detergent is added. The beaker is then held over the water present inside the sonicator (ultrasonic cleaner) for 5 mins. Then the soapy water is discarded.

(ii) The beaker is now half filled with millipore water and the again the step (i) is repeated.

(iii) Finally, the beaker is half filled with acetone and again step (i) is repeated.

(iv) The ITO coated glass pieces are then dried.

After completing the cleaning process, the resistance is again checked and the ITO coated glass plates are numbered on the plane glass portion. To do the spin coating, we follow the following process:

(i) The spin coater (Model: spinNX G-M1) is switched on. The warm up button is pushed first and at the end of this session the green light of the system ready will glow automatically.

(ii) The lid of the spin coater is opened and a hard, thick paper material having gum at the upward portion is attached to the spindle.

(iii) The one piece of ITO coated glass plate with the ITO portion upward is kept tied over the spindle with the material [step (ii)]. The lid is covered.

(iv) The calibration switch is pushed to start this session. The green light would be automatically turned on as the calibration of the system is over. (It is to be noted that if all pieces of ITO coated glass are of the same size, no
calibration is needed in the process of spin coating. But if any of them is not of the same size then we have to again calibrate the spin coater for it).

(v) The RPM (Revolution Per Minute) is adjusted to 3000 and the Time is set for 1 minute.

(vi) The lid is opened and one drop of the sample is poured over the substrate and the lid is closed. The ‘Run ‘switch is pushed and the system stops automatically when the the green light of the system ready glows as usual. The spin coating is then repeated for making of other layers. The devices take a complete form when Aluminium cathodes are deposited by thermal evaporation through a shadow mask at a vacuum chamber at a pressure of $10^{-5}$ mbar.

The as-fabricated devices are then utilized for measuring the dark as well as the light characteristics in the solar stimulator (Photo Emission Tech. INC, CAMARILLO< CA 93012 USA, Model # CT50AAA, Serial # 1056).

(b) Ag/PVA devices:

For fabrication of Ag/PVA devices, a Printed Circuit Board (PCB) is taken. A small area is marked by a marker and the sides surrounding this area are painted. The board is now placed in the solution of FeCl₃ for some hours. It is then taken out. The paint is removed. The marked area is now devoid of Cu. Now a drop of Ag/PVA sample solution is casted and is allowed to dry. The two sides act as the electrodes.

(c) Energy band diagram of one as-fabricated PbS/PVA QD device
APPENDIX II

6.2.4 Statistical Analysis

(a) **Analysis of variance**: The data obtained are tested for the difference among the number of components associated with the nature of classification of data. The systematic procedure for obtaining this is called Analysis of Variance. With the help of this technique, it is possible to perform certain tests of hypothesis and to provide estimates for the components of variation. The total variation is measured by the sum of squares (SS) of deviation of yield from the mean yield. This method consists of portioning the total variation observed in the data into various assignable causes arise out of uncontrolled factors.

(b) **Randomised Block Diagram**: Suppose the experimental material is divided into ‘r’ blocks and let there be ‘t’ block divided into ‘t’ units and the treatment are allocated within a block of random. The resulting design is called Randomized Block Diagram (RBD). The principal advantage of RBD is that it increases the precision of the experiment. The amount of information obtained in RBD is more efficient. Any number of replications can be included in RBD.

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Correlation formula
Grand Total (GT) = Sum of all replications

Correlation Factor (CF) = Sum of all replications / Total no. of observations

Raw Sum Square = sum of squares of individual observations

Total Sum of Squares (SS) = Raw sum of squares - CF

Summation square of a parameter (SS) = Total sum of squares of the particular parameter / No. of replications

Error Summation Square (ESS) = Total summation square - summation square of the parameter

Degrees of freedom (d.f) = No. of observation - 1

Mean Sum of Squares (MSS) = Sum of squares of a particular observation / d.f of that observation

Error MS = Error summation square / Error degree of freedom

After calculating the different MSS, the value of the same MSS for experimental factors and their interactions were divided by error MSS to calculate the F values
1. Analysis of Variance Table

Table 5.2

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Summation Square</th>
<th>Mean Square (MSS)=ss/df</th>
<th>Calculate F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>p-1</td>
<td>Treatment SS</td>
<td>Treatment MSS</td>
<td>Treatment MSS/Error MSS</td>
</tr>
<tr>
<td>Period</td>
<td>q-1</td>
<td>Period SS</td>
<td>Period MSS</td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>(p-1)(q-1)</td>
<td>Error SS</td>
<td>Error MS</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>pq-1</td>
<td>Total SS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*(c) Critical Difference (CD):* The analysis of variance table gives only a broad indication of performance of the concentrations, duration of treatments in growth rate parameters. But in order to get clear appraisal of the specific phenomena, calculation of critical difference was considered necessary.

\[ \text{CD}(0.5) = \frac{\text{Error MSS}}{n} \]

Where \( n = \) Total units/ Individual units

*(d) Mean:* It is the sum total of the entire individual observations or measurements and dividing the total by the number of observations or measurements.

*(e) Test of Significance:* The method of calculating the probability of obtaining an observed result from some hypothesis and regarding the hypothesis to be rejected or
not, is known as the test of significance. If the calculated value is greater than some pre-selected value, the observation result is said to be statistically significant at a chosen value of probability. If the calculated value is more than the tabulated value at 1% probability, then it is said to be highly significant and if the calculated value is lower than the value at 1% probability, it is said to be significant. In the biological experiments generally, probability of 0.05 is also referred to as 5% level of significance. From the calculations, the result is compared with the standard values for different probability distribution from statistical analysis.