

Quantum Dots Material Jetting on MicroLEDs

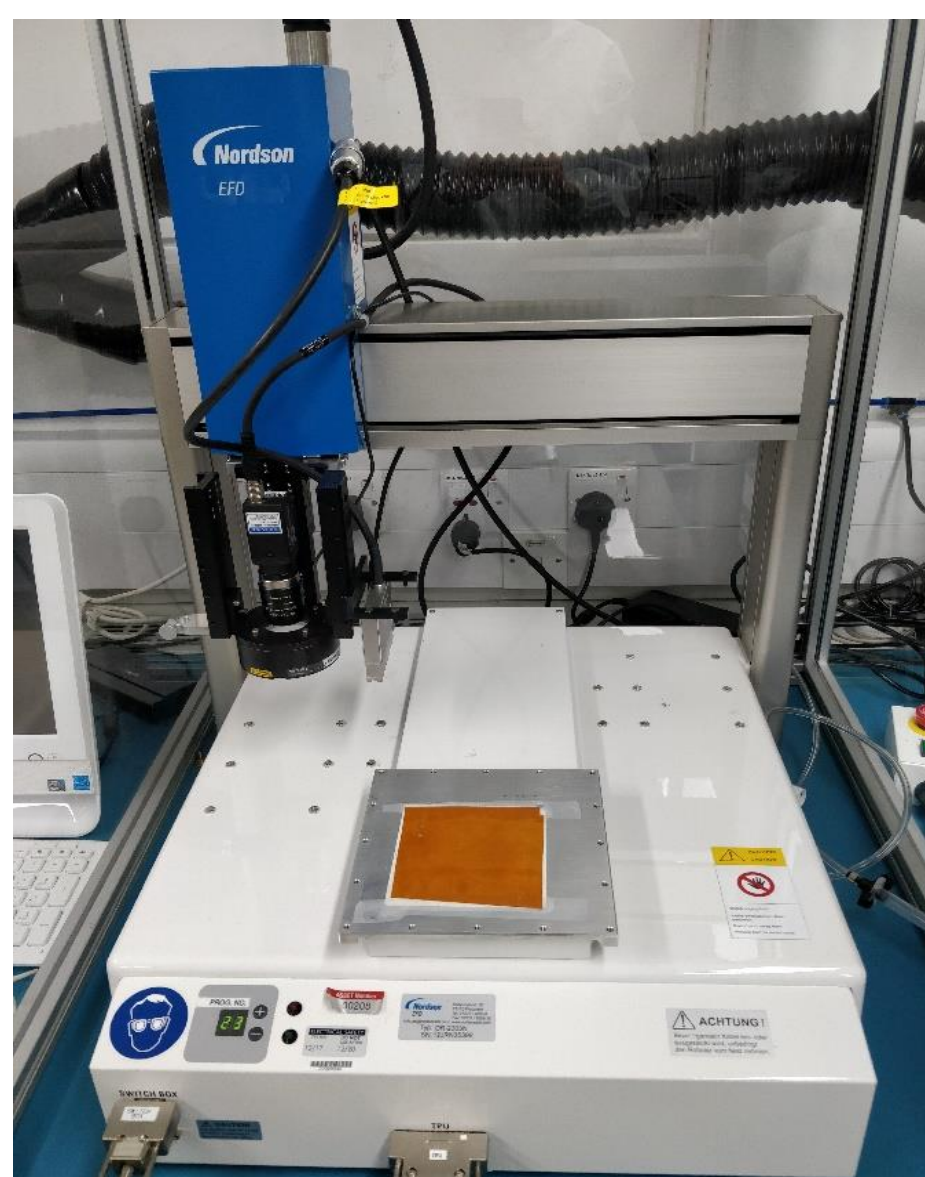
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Introduction

Our project focuses on jetting QD material onto the surfaces of LEDs. QDs are a material used to absorb light and emit it at a lower frequency. The reason why one might want to do this is because blue LEDs are more efficient than green and red LEDs and the green variety is quite hard to fabricate. Using QDs one can just use blue light and convert that to any color lower in the visible EM spectrum. Because of this, QDs are used in displays.

Another use for this material is in solar cells. Photons of higher energy than the threshold for absorption will just turn the extra energy into heat. In solar cells heat decreases performance. Another problem is that higher frequencies will result in absorption closer to the surface, meaning that the electron and the hole generated will not be within the electric field of the depletion region. By using QDs one can make all incident photons have the perfect amount of energy (or at least close to perfect since the number of materials used is finite).



Using the robots

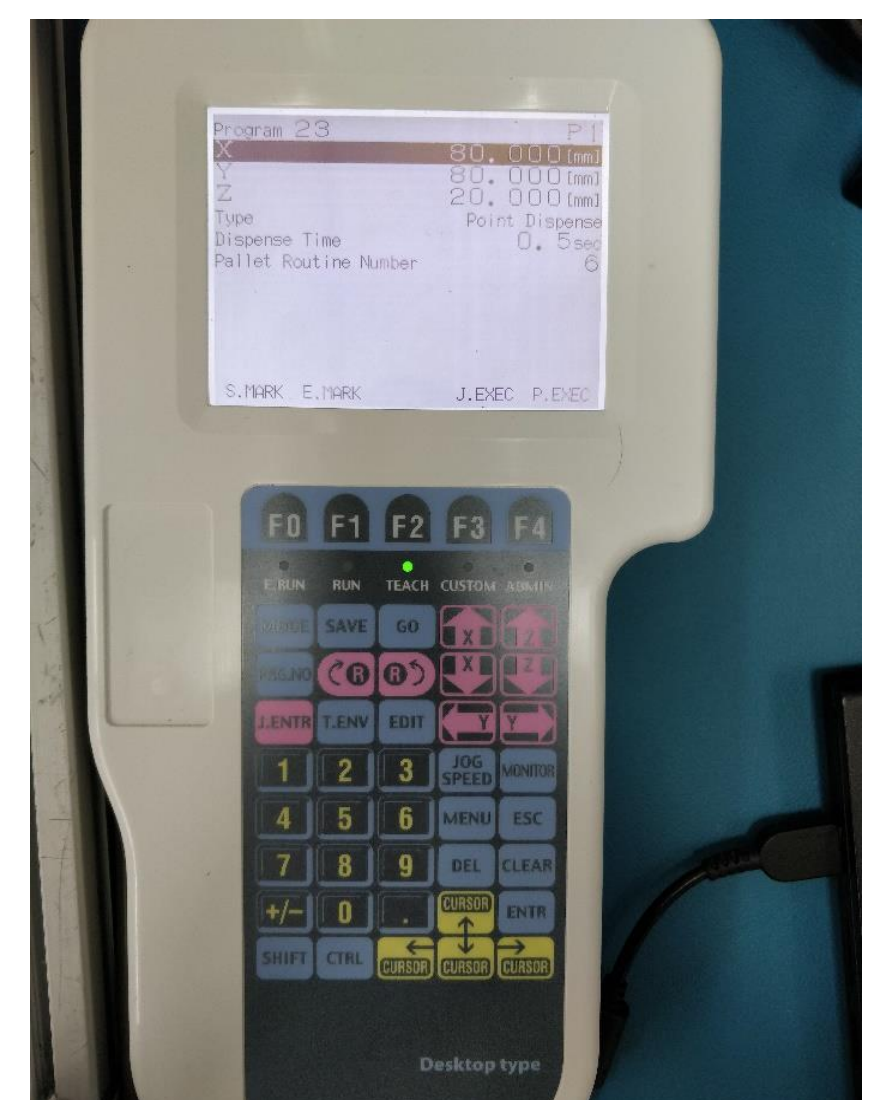
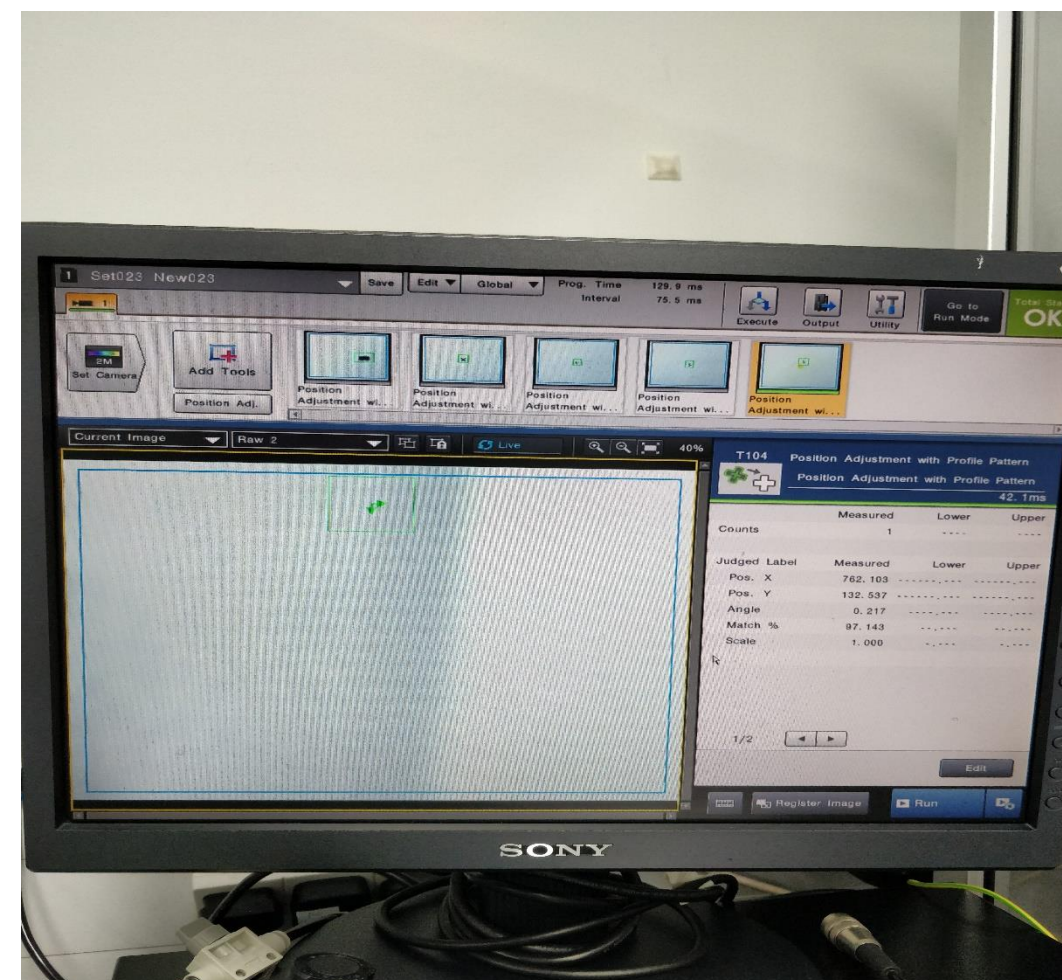
Dispensing is a process in which a material is deposited on a substrate. The dispenser can deposit controlled quantities of materials in precise locations on a substrate. It can offer a wide choice of design where a material can be deposited in any pattern. Dispensing can be used for creating stacked structures (with multiple layers) which can consist of various materials.

The first machine is used for dispensing. It is programmed using the “Robot Vision” software. When dispensing, the user should take into account the offset between the camera and the tip. This is because the coordinates for the commands are the ones for the center of the camera. Depending on the viscosity of the dispensed fluid one would want to adapt certain parameters such as line speed, tail time, head time and pressure.

The second robot is used for jetting the QD material. This system is made out of several parts: the robot, the camera, the programming device, a controller for the valves, the Pico-jet and a computer where the camera program runs. The camera program can be used for a plethora of applications, but in this case it is used to locate the relative position of the LEDs that need to have QDs from the center of the camera. The device used for programming is called a teaching pendant and it has several modes of operation. All of the programming and testing can be done using just the Teaching Mode. The parameters that need adjusting with different viscosities in this case are pulse time (on the valve controller) and pressure.

Experiments

Most of the time was spent into figuring out how the camera program works with the teaching pendant, getting the jetted dots to be smaller and more circular (to make sure that the material does not split) and fine tuning the parameters for the material used by the dispenser. The first experiments done with the dispenser were just drawing shapes and writing names using textile paint. For the jetting system the first experiments consisted of just programming and testing the system without dispensing. In the next phase isopropanol was used as jetting material, but was difficult to see what was happening since it is colorless and evaporates fast. After that, the QD material was used.



Command	1	2	3	4	5	6
1 Initialize						
2 Point Dispensi	0.1	0.03				
3 Line Speed	60					
4 Dispensing En	15	5	15			
5 Line dispense	0.05	0.1	0.05	0.8		
6 Z Clearance S	20	0				
7 Line Start	100	120	61			
8 Line End	100	160	61			
9 Line Start	100	120	61			
10 Arc Point	110	130	61			
11 Line End	100	140	61			
12 Line Start	120	120	61			
13 Line End	120	160	61			
14 Line Start	140	120	61			
15 Line End	140	160	61			
16 Line Start	140	120	61			
17 Line End	150	170	61			

Conclusions

Dispensing is a complex task that involves many parameters. Therefore a person doing this should not be surprised by the sheer amount of trial and error involved. During the course of our internship we were required to reach some predetermined milestones. Most of which has already been met and other that we are just about to begin. This experience gave us the opportunity to gain a greater understanding about safety regulations in compliance with the laboratory environment rules. Part of the information regarding the aim of this research project couldn't have been disclosed in this document due to the confidential nature of this internship.

Bibliography

1. Jetting Robot Instructions, Rachel Yu 02/07/2018
2. Janome Desktop Robot JR2000N Series (Operational Manual, Teaching Pendant Operation)
3. F7000N Series 3-Axis Robot Operating manual (Apr 2011)
4. F7000NV Robot Vision Operating Manual (Dec 2011)