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Development of AMOLED TFT crystallization system using an excimer laser and XY stage.

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Abstract
This paper presents the development of an AMOLED TFT crystallization system using an excimer laser and a XY linear motor stage. The system consists of a laser optics part and a stage part. The laser optics part includes 5 parts; excimer laser, beam expanding module, homogenizer module, field lens module and projection lens module. To manufacture uniformly, homogeneous illumination by the laser beam is required. Final dimension of laser beam is 370 X 0.4 mm(X,Y). Homogeneities of beam are 2.26%(X), 2.66%(Y). The stage controls the location of the specimen. The stage consists of a linear motor and an air bearing. The size of the stage is 1750 X1000 X 1000 mm^3 and the size of moving plate is 650 X 650 X 100mm^3. Also, specimen size is 650 X 650 mm^2. To manufacture a whole specimen the stage travels forwards and backwards.

Key words : Beam homogenizing, TFT crystallization, AMOLED

1. Introduction

For the last ten years, display manufacturing industry has grown extensively. Nowadays, AMOLED and flexible display is most ascendant technology in recent display industry. In AMOLED manufacturing process, TFT crystallization is a key point of technology. Recently TFT crystallization process uses an excimer laser making polycrystal silicon[1]. In TFT crystallization process, uniform intensity square beam which has flat-top profile is required[2,3].

In this study, we developed line beam optics for TFT crystallization and linear motor stage to move a specimen.

2. System description

The developed TFT crystallization system consists of two parts; laser optics which makes a line beam and a stage which moves the specimen.

2.1. Laser optics

Figure 1 shows schematic view of laser optics.

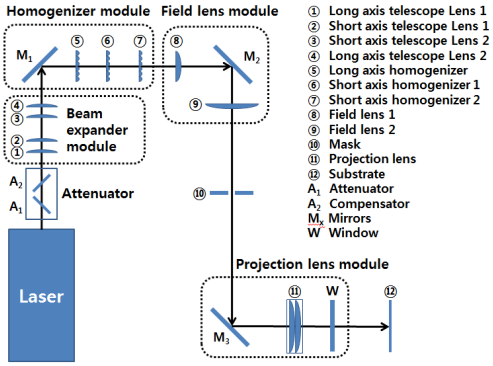

Figure 1. schematic view of laser optics

The laser optics consists of 5 parts; laser, beam expanding module, homogenizer module, field lens module and projection lens module. The laser beam has a size of 370 X 0.4 mm (X, Y) after passing 5 parts of optics.

The beam expanding module expands a beam to the desired size. Two cylindrical lenses are used to control the size of the beam. The beam homogenizer makes a beam uniform. Commonly, a laser beam has a Gaussian profile. Therefore, it needs to control uniformity of beam. 22 cylindrical lenses are used to control long axis(X) homogeneity. 12 cylindrical lenses are used to control short axis(Y) homogeneity. And field lens module control the size of beam. The field lens consists of two lenses. Finally, projection module control depth of focus of beam. Controlled depth of focus of beam is ±100um. It means flatness of stage is less than ±100um.

Homogeneity of beam is measured using CCD camera. Figure 2 shows a manufactured laser optics, and Figure 3 shows x, y-axis homogeneities of beam.

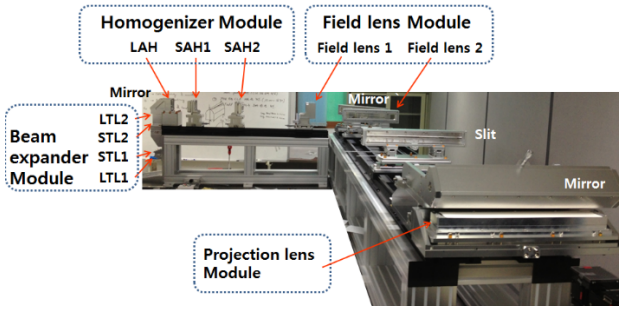

Figure 2. manufactured laser optics

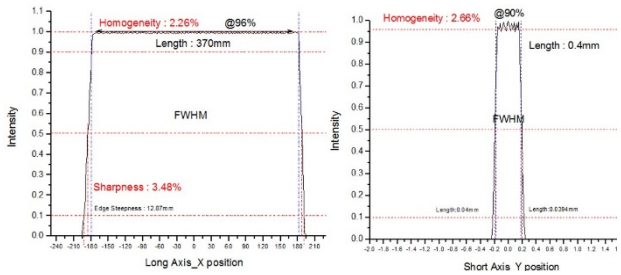

Figure 3. homogeneity of beam

X-axis homogeneity is 2.26% and Y-axis homogeneity is 2.66%. From the results, the beam has a reasonable homogeneity.

2.2. Stage

Figure 4 shows the manufactured stage which can locate a specimen to a desired position.

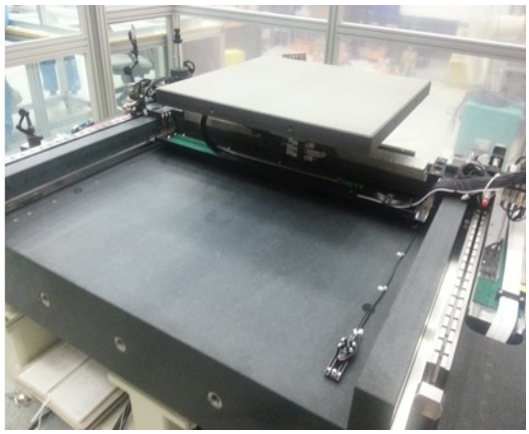

Figure 4. manufactured stage.

The stage moves the X and Y-axis direction to locate a specimen to a desired position. Two linear motors generate Y-axis motion and one linear motor generates X-axis motion. To reduce velocity ripple, an air bearing is used. The stage performance specifications are shown in Table 1.

Table 1 Performance of stage

Working range	650 X 650 mm^2 (X, Y)
Max. acceleration	2700mm/s^2 (X, Y)
Velocity Ripple (@ 10mm/s)	±0.36% (X), ±0.369% (Y)
Inposition stability	±20nm (X, Y)
Flatness	5.694 um

Detailed performance is shown in figure 5.

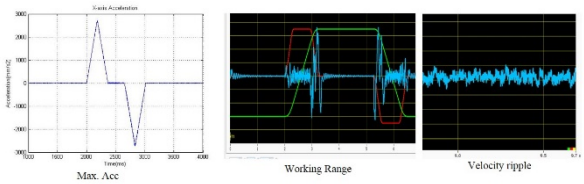

Figure 5. Detailed performance

From the performance of stage, we predict no problem in TFT crystallization process.

5. Conclusion and Future work

In this study, we developed an AMOLED TFT crystallization system using an excimer laser and XY stage. The Laser part has 370 X 0.4 mm^2 of beam size and 2.26%, 2.66% of homogeneity. And the stage has 650 X 650mm^2 of working range, ±0.36% (X), ±0.369% (Y) of velocity ripple and 5.694um of flatness.

Future research includes the experiments of AMOLED TFT crystallization and verify the quality of manufacturing.

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