

Chapter 9

Conclusions

A systematic study has been carried out on the characterization of wide gap hydrogenated amorphous silicon alloy materials, so-called a-SiN:H, a-SiC:H and a-SiO:H and their applications to visible-light amorphous thin film light emitting diodes (TFLEDs). The TFLEDs consisting of the amorphous silicon alloy p-i-n junctions have been developed for the first time. A series of investigations on the basic device characteristics and some attempts to improve the brightness have been done. A dot matrix amorphous TFLED display has been fabricated for the first time. A novel amorphous photocoupler consisting of the amorphous TFLEDs and amorphous photodiode has also been developed. Results obtained in this thesis work are enumerated as follows:

- 1) A vertical type RF glow discharge plasma CVD system was installed. The effective diameter of the area of the deposition is about 8 cm. A good uniformity of the thickness could be obtained. The installed system can be used for the deposition of the electronic grades of a-SiN:H, a-SiC:H and a-SiO:H. It will be shown in chapters 3-5 that the visible-light thin film LEDs (TFLEDs) with amorphous silicon alloy p-i-n junctions could be fabricated by the CVD system.
- 2) A series of systematic investigations has been done on the structural and optical properties of a-SiN:H characterized by IR absorption, ESR, optical absorption and photoluminescent (PL) measurements. It has been shown that the undoped a-SiN:H possessing a wide range of optical energy gap from 1.8 eV to 3.1 eV could be prepared by adjusting the ratio of the nitrogen source gas (ammonia gas) to the silane gas.
- 3) The PL emission color of a-SiN:H changes from red to green along with the increase in the optical energy gap. The PL peak energy was somehow smaller

- 23) It has been clarified that there was no cross talk in the display, and the minimum spacing distance between the adjacent two ITO or Al electrodes could be as small as the order of μm .
- 24) The dot matrix amorphous TFLED could be operated in a scanning mode at the frequency as high as 100 kHz.
- 25) Hydrogenated amorphous silicon alloy photocouplers have been developed for the first time. The light source was made of an a-SiC:H TFLED and the light detector was made of an a-Si:H TFPD (thin film photodiode).
- 26) Two types of the photocouplers were fabricated.
 - In type I, so-called photo-interrupter, a TFLED and a TFPD were fabricated on the two separating glass substrates.
 - In type II, so-called photo-isolator, a TFLED and a TFPD were fabricated on the dual surfaces of a common glass substrate.
- 27) The coupling efficiency of the photocouplers was approximately 10^{-5} %. The amorphous photocouplers could be operated up to the frequency of several hundred kHz.
- 28) It was considered that the amorphous photocoupler could be possible in a mass production industry.