論文 / 著書情報
Article / Book Information

題目(和文)	アレイ型半導体デバイスにおける自己センシングシステムの研究
Title(English)	Study on self - sensing system of semiconductor array devices
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Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	電気電子 エネルギー	系 コース	
学生氏名： Student's Name	河野　亨		

申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of　（工学）
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

The self-sensing system was developed for semiconductor array matrices, in which semiconductor elements such as transistors and diodes are arranged in an array. Semiconductor array matrices can be classified as active or passive matrix arrays. In this study, the system was equipped to both passive and active array matrices. An array matrix possessing a cell with a transistor, as discussed above, is defined as an active array matrix, and an array matrix possessing a cell in which the main element is a diode is defined as a passive array matrix. The minimal unit of a semiconductor matrix is called a cell, and a unit in which these cells are arranged in an array is called a cell array. In an active array matrix, a row decoder and a column decoder are equipped on the semiconductor array matrix, and the cell to be sensed is selected by these decoders. Here, the data of the selected cell is detected using a driver with as few configurations as possible. In a passive array matrix, it is common for a driver to be installed to operate the cell array. Therefore, additional sensors and drivers are not required.

In an active array matrix, peripheral circuits and transistors control an operating point on the I-V curve before manufacturing parameters are calculated. In contrast, in a passive array matrix, environmental parameters that indicate an operating point on the I-V curve, such as operating temperature of the array matrix, are estimated by a circuit model, device model, and sensed data.
In Chapters 2, 3, 4, and 5, forming Part I, the self-sensing system was applied to an active-matrix organic light emitting diode (AM-OLED) display, an active array matrix. Peripheral circuits and transistors in an active matrix array control an operating point of a drive thin film transistor (TFT) on an AM-OLED. Each pixel's Vth of the drive TFT on the AM-OLED is sensed as a manufacturing parameter.

To evaluate the effectiveness of the proposed method, a prototype 3.8-inch 480×320-ppi OLED was built in Chapter 4. From the Vth-distribution image, an offset signal for compensating Vth variation was generated, and the variation of Vth was compensated for by adding the offset signal to the data signal. We found that the OLED panel produces highly uniform pictures when this compensation is applied. This means that the self-sensing system can monitor not only the blob mura and around gap mura but also the analog characteristics of each cell (pixel) in cell array using the minimum sensor configuration (current source and voltage detector). That is, it was shown that a self-sensing system was feasible.

In Chapters 6, 7, 8, and 9, forming Part II, the application of the self-sensing system to a Photovoltaic (PV) system, a passive array matrix, is described. The power generated by a PV system is influenced by fluctuations in environmental parameters, such as temperature and irradiation. First, environmental parameters were estimated using a circuit model, device model, and sensed data. Environmental parameters indicated an operating point on the I-V curve, e.g., operating temperature, of the PV system. Next, faults and degradation were calculated as the manufacturing parameters using the estimated environmental parameters. A PV diagnostic system connected by a virtual private network was constructed to apply this architecture to three large-scale PV power plants. We experimentally demonstrated that this architecture can determine the number of faulty modules even for a loss of less than 0.2%. We also experimentally found that it can accurately determine the cause of failure and degradation, namely, series-resistance increase, shunt-resistance decrease, or bypass diode on, even for a loss of less than 5-6%. This means that not only the faulty module can be replaced before the DC ground fault but also the timing of the maintenance can be remotely monitored and the labor and the cost are greatly reduced. That is, it was shown that a self-sensing system was feasible.

In the application of the self-sensing system discussed above, high-precision detection of manufacturing and environmental parameters can be achieved without additional sensors or with minimal configuration. However, existing sensors and installed minimal configuration sensors are not always measurable with sufficient accuracy and resolution. In Chapter 10, as considerations for future work, we discussed the implementation of machine learning for further accuracy improvement and expansion of application to array matrices with cells that are not semiconductors. By implementing machine learning, the sensing of parameters of an array matrix composed of non-semiconductor cells such as a Lithium-ion battery system and a medical sensor system may be accomplished.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).
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