Science and Technology English I II

Exercise 08 Meiji University

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http://mikami.a.la9.jp/mdc/mdc1.htm

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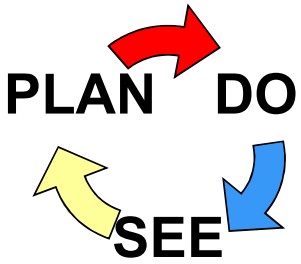
Day 8 Exercise



2 グループで課題を進める

- Aグループ
  - 3-14 :
  - 3-15 :
  - 4-14 :
  - 4-15 :
- Bグループ
  - 3-14 :
  - 3-15 :
  - 4-14 :
  - 4-15 :

課題1 p18 [STE-101-201]
THE DEVICES 2.1 Introduction

- Aグループ
  - 5つのパラグラフを要約して自分流で英文で簡潔にまとめる(箇条書きでもよい)。(本文を切り取ったまる写しは不可)
- Bグループ
  - 5つのパラグラフの要約を和文で箇条書きにする。

ABグループ共通課題 2

- 課題2 p19 [STE-101-202]
  - 2.2.1 A First Glance at the Device
  - 10行を和訳する(グループA/B 共通)

2.1 Introduction

前提

領域

It is a well-known premise in engineering that the conception of a complex construction without a prior understanding of the underlying building blocks is a sure road to failure. This surely holds for digital circuit design as well. The basic building blocks in this engineering domain are the silicon semiconductor devices, more specifically the diodes, and the MOS and bipolar transistors.

記号、符号

協定、協約

Giving the reader the necessary *knowledge and understanding of these devices* is the prime motivation for this chapter. It is not our intention to present an in-depth discussion (we assume that the reader has some prior familiarity with electronic devices). The goal is rather to refresh the memory, to introduce some notational conventions, and to highlight a number of properties and parameters that are particularly important in the design of digital gates. We further identify the fundamental differences between bipolar and MOS transistors that helps to explain the differences in the topology of digital circuits manufactured in those technologies.

両立しないことについて妥協を得る

位相幾何学

手に負えない

Another important function of this chapter is the introduction of the *device models*. Taking all the physical aspects of each device into account when designing complex digital circuits leads to an unnecessary complexity that quickly becomes intractable. Such an approach is similar to considering the molecular structure of concrete when constructing a bridge. To deal with this issue, an abstraction of the device behavior called a *model* is typically employed. A range of models can be conceived for each device presenting a trade-off between accuracy and complexity. A simple first-order model is useful for manual analysis. It has limited accuracy but helps us to understand the operation of the circuit and its dominant parameters. When more accurate results are needed, complex, second- or higher-order models are employed in conjunction with computer-aided simulation. In this chapter, we present both first-order models for manual analysis as well as higher-order models for simulation for each device of interest.

1次モデル

支配的な

Designers tend to take the device parameters offered in the models for granted. They

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支配的な

1次モデル

Designers tend to take the device parameters offered in the models for granted. They should be aware, however, that these are only nominal values, and that the actual parameter values vary with operating temperature, over manufacturing runs, or even over a single wafer. To highlight this issue, a short discussion on *process variations* and their impact is included in the chapter.

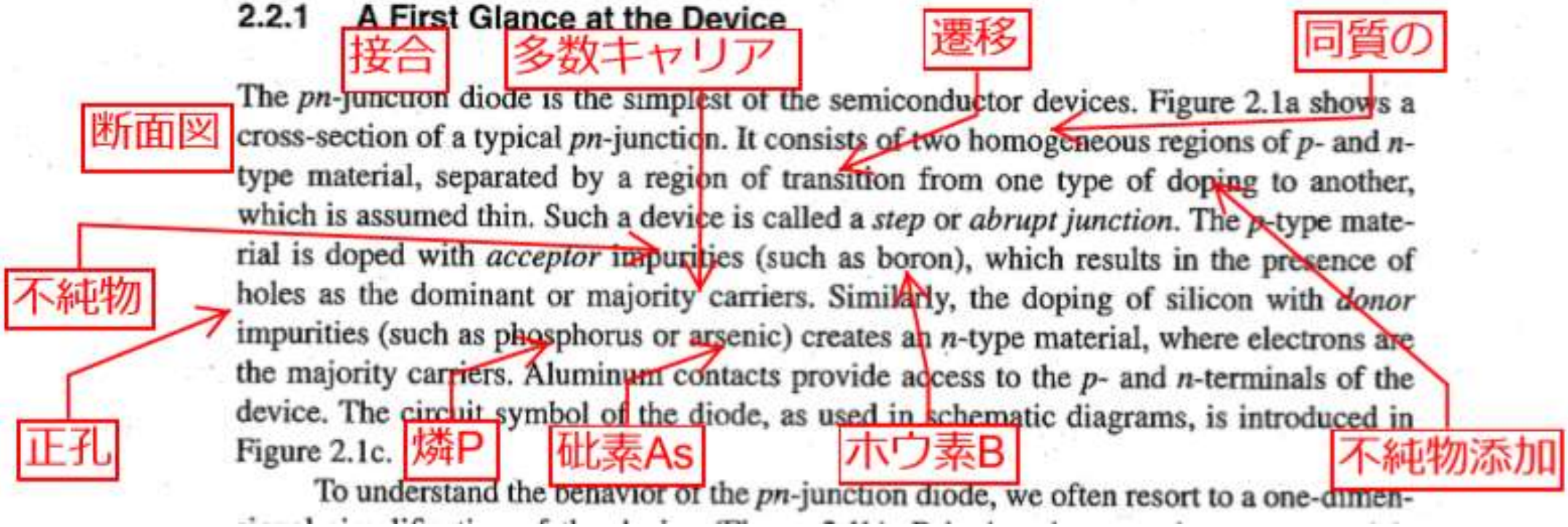
概観、側面

変動

Since this text focuses on the *design aspect* of digital integrated circuits, a mere presentation of an analytical model of a device is not sufficient. Turning a conceived circuit into an actual implementation also requires a knowledge of the manufacturing process and its constraints. The interface between the design and processing world, is captured as a set of *design rules* that act as prescriptions for preparing the masks used in the fabrication process of integrated circuits. The design rules for a representative IC process are introduced in Appendix A to this chapter. A detailed description of IC fabrication processes is beyond the scope of this textbook.

処方箋

2.2.1 A First Glance at the Device



The *pn*-junction diode is the simplest of the semiconductor devices. Figure 2.1a shows a cross-section of a typical *pn*-junction. It consists of two homogeneous regions of *p*- and *n*-type material, separated by a region of transition from one type of doping to another, which is assumed thin. Such a device is called a *step* or *abrupt junction*. The *p*-type material is doped with *acceptor* impurities (such as boron), which results in the presence of holes as the dominant or majority carriers. Similarly, the doping of silicon with *donor* impurities (such as phosphorus or arsenic) creates an *n*-type material, where electrons are the majority carriers. Aluminum contacts provide access to the *p*- and *n*-terminals of the device. The circuit symbol of the diode, as used in schematic diagrams, is introduced in Figure 2.1c.

To understand the behavior of the *pn*-junction diode, we often resort to a one-dimen-

Memo

フォローアップURL (Revised)

http://mikami.a.la9.jp/meiji/MEIJI.htm

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