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

In this thesis, single molecular transistors based on quinoidal fused oligosilole derivatives and heteroepitaxial spherical (HS) Au/Pt nanogap electrodes have been fabricated and measured. The objective of this thesis is to demonstrate room temperature operable single molecular resonant-tunneling transistor (RTT). To reach at this objective, initially I have optimized anchor/linker group for demonstration of RTT operation. For demonstration of RTT operation, it was the most important to choose proper length of anchor/linker group. In this study, quinoidal fused oligosilole derivatives such as Si-1, Si-2 and Si-2x2 have been studied. In chapter 2, Si-2 derivative did not show RTT operation but single-electron transistor (SET) operation. Finally, it was experimentally demonstrated RTT operation in chapter 3.

Subsequently, I have concentrated on demonstration of room temperature operation of single molecular transistor. At first, room temperature operable single molecular SET was targeted in chapter 4. Especially for demonstration of RT operable single molecular SET, charging energy has to be considered. Si-1 derivative was chosen owing to its high expected charging energy originated by its small size. Not only charging energy but also device structure is more critical for stable RT operation in single molecular transistor. Here, I supposed that single molecular transistor might be the most stable if both ends of anchor/linker group made chemical S-Au bonds with electrodes. By demonstration of this chemically bridged device structure, extremely stable RT operation of single molecular SET was clearly observed with Si-1 derivative in chapter 4.

Finally, room temperature operable single molecular resonant-tunneling transistor (SMRT^2) has been clearly observed with Si-2x2 in chapter 5. In this chapter, additional self-assembly monolayer (SAM) was introduced. It was because introduced SAM can effectively block to form one side chemically bonded device structure. I summarized thesis by every chapters as follows:

• Chapter 1: Introduction

In this chapter, I explained the requirement and necessity of realizing single molecular transistor as the next-generation transistor. Then, I introduced several nanogap electrodes fabrication methods. Moreover, basic principle of tunneling mechanisms are explained. Then, reported papers were classified regarding to above tunneling mechanisms. And then, motivation of study and main objective of this thesis were clearly shown.

• Chapter 2: One side chemisorbed Si-2 single molecular single-electron transistor

A Si-2 derivative was introduced between HS-Au/Pt nanogap electrodes.

Single-electron transistor (SET) operation was clearly observed. Distinguishing dI/dV peak has been also observed together with SET properties. This dI/dV peak might be originated by molecular orbital.

• Chapter 3: One side chemisorbed Si-2x2 single molecular resonant-tunneling transistor

In chapter 2, Si-2x2 derivative has been introduced between HS-Au/Pt nanogap electrodes. RTT operation has been clearly observed in Si-2x2 single molecule transistor. RTT operation and temperature dependence of RTT operation were discussed in chapter 3.

• Chapter 4: Room temperature operation of bridged single molecular single-electron transistor based on Si-1

All of experimental results of SET and RTT indicated one side chemisorbed device structure as shown in chapter 2 and chapter 3. In chapter 4, chemically bridged device structure has been prepared. Consequently, room temperature operable single molecular SET has been demonstrated.

• Chapter 5: Room temperature operation of bridged single molecular resonant-tunneling transistor based on Si-2x2

In chapter 5, stable room temperature operation of SMRT[2] was clearly observed with Si-2x2 by forming chemically bridged device structure. Additional SAM was introduced prior to immerse Si-2x2 derivative to increase the possibility of forming bridged device structure.

• Chapter 6: Conclusions

In chapter 6, I summarized this thesis of study on room temperature operable single molecular transistors. And, I mentioned about future perspectives on this thesis.