

論文 / 著書情報  
Article / Book Information

|                   |                                                                                                                                                                             |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 題目(和文)            |                                                                                                                                                                             |
| Title(English)    | Development of efficient manufacturing methods of micro/nano metallic structures on glass substrates                                                                        |
| 著者(和文)            | Potejana Potejanasak                                                                                                                                                        |
| Author(English)   | Potejanasak Potejana                                                                                                                                                        |
| 出典(和文)            | 学位:博士(工学),<br>学位授与機関:東京工業大学,<br>報告番号:甲第10315号,<br>授与年月日:2016年9月20日,<br>学位の種別:課程博士,<br>審査員:吉野 雅彦,井上 裕嗣,平田 敦,赤坂 大樹,山本 貴富喜                                                     |
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| 学位種別(和文)          | 博士論文                                                                                                                                                                        |
| 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

|                |                                    |    |
|----------------|------------------------------------|----|
| 専攻：            | Mechanical and Control Engineering | 専攻 |
| Department of  |                                    |    |
| 学生氏名：          | POTEJANA Potejanasak               |    |
| Student's Name |                                    |    |

|                           |                  |
|---------------------------|------------------|
| 申請学位 (専攻分野)：              | 博士 (Engineering) |
| Academic Degree Requested | Doctor of        |
| 指導教員 (主)：                 | 吉野 雅彦 教授         |
| Academic Advisor(main)    |                  |
| 指導教員 (副)：                 | 山本 貴富喜 准教授       |
| Academic Advisor(sub)     |                  |

要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words )

In this research project, new efficient manufacturing processes of metallic nanostructures on substrates are developed for the development of plasmonic nano devices. In order to produce Au nanodot arrays at high through-put and low production cost, new fabrication processes of metallic nanostructures by the combination of top-down and bottom-up approaches are proposed. These processes are based on a new idea to utilize the nano imprinting method with polymer mold as the top-down approach, sputter coating and self-organization by thermal dewetting is employed as the bottom-up approach. Feasibility of these processes are studied experimentally. Nanodot arrays and nanowire structures were manufactured by the proposed method.

In this study, a polymer mold was used as an imprinting mold. It was prepared by hot embossing nano patterns of a mother mold on a Cyclo Olefin Polymer (COP) film. A mother mold was prepared from a silicon wafer by photolithography method. Polymer mold was used for nano imprinting for the template thermal dewetting process. For the first proposed method, the direct nano imprinting is utilized as the top-down approach. A polymer film mold is used for direct nanoimprinting on a metal film deposited on a substrate. Then, self-organization of metal nanodots by thermal dewetting was studied. The experimental results shown that COP film mold is effective to form a micro groove pattern on the Au thin film. It is also revealed that the micro groove on the Au film is effective to align nanodots in lines. It is also confirmed that the micro grooves patterning by the COP film mold is useful to control dot size and dot alignment in the thermal dewetting process. For the second proposed method, the nano chemical stamping method is utilized as top-down approach. A pattern of micrometer size is printed with acetone on the substrate by means of stamping with COP film stamp. Then, a gold film is deposited on the substrate. Substrate is annealed to arise self-organization of metal nanodots. Since the acetone stamped on the substrate reduce surface energy of substrate, and they affect the contact angle of gold nanodots, gold nanodots are distributed along with the stamped pattern. It is revealed that the pattern stamped with acetone on the substrate works as a template of the thermal dewetting process. Nano chemical stamping technique is useful to control the distribution of nanodots size. For the third proposed method, a new efficient to fabricate metallic nano-wires structure is developed. The combination of nano chemical stamping with a polymer stamp and selective peeling technique was examined experimentally. The experimental results shown that the acetone bands and space bands pattern of Au thin film obviously appears on the substrate. Since acetone stamped on the substrate reduce the surface energy of substrate related to the adhesion between Au film and substrate is decreased. Therefore, the acetone bands were easily peeled off by an adhesive. However the gold film in the space bands stuck on the substrate as nano-wires structure. It is demonstrated that the nano chemical patterns stamped with acetone on the substrate works as a template of selective peeling process. Nano chemical stamping technique is useful to produce metallic nano-wires structure.

In addition, the optical properties of the nanostructures on substrate were studied by measuring the extinction spectrum. It is found that the metallic nanostructures fabricated in this study exhibit strong extinction spectrum due to the Localized Surface Plasmon Resonance (LSPR).

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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