論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Efficient Fabrication Process of a Metallic Nano Dot Array on a Plastic Substrate by the Nano-Plastic Forming Assisted Thermal Dewetting Method
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出典(和文)	学位:博士(学術), 学位授与機関:東京工業大学, 報告番号:甲第9568号, 授与年月日:2014年3月26日, 学位の種別:課程博士, 審査員:吉野　雅彦,井上　裕嗣,山本　貴富喜,山崎　敬久,平田　敦
Citation(English)	Degree:Doctor (Academic), Conferring organization: Tokyo Institute of Technology, Report number:甲第9568号, Conferred date:2014/3/26, Degree Type:Course doctor, Examiner:,,,,
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： Department of	Mechanical and Control Engineering 専攻	申請学位（専攻分野）： Academic Degree Requested	博士 (Philosophy) Doctor of
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

In this thesis, a new process for fabrication of an ordered metallic nano dot array on a plastic substrate by the nano-plastic forming assisted thermal dewetting method and dot transfer technique is proposed. The feasibility of the proposed process is verified through the experiments. The content of this thesis is presented into five chapters as follows:

Chapter 1 – INTRODUCTION: This chapter firstly covers the research background which relates to applications, history of nanotechnology, and nanofabrication techniques. It appears that both the top-down and bottom-up nanofabrication techniques exist the drawbacks and limitations. The combination process of the top-down and the bottom-up methods is expected to overcome these drawbacks and limitations. The motivation and objective of this research is to overcome these limitations by development of an efficient process for fabrication of a metallic nano dot array on a plastic substrate (also called as plastic film in this study. The word "plastic film" implies a thin plastic sheet in the fabrication process while the word "plastic substrate" implies a thin plastic sheet in the final products or in applications).

Chapter 2 – LITERATURE REVIEW: This chapter firstly reveals that nano dot arrays have broad applications to various fields such as bio-sensing and electrical/electronic devices. The future trend of applications of nano dot arrays shows great demands of ordered nano dot arrays with good uniformity and regularity. In addition, fabrication of ordered nano dot arrays on plastic substrates is highly desired for the development of organic electronic devices.

Furthermore, this chapter also overviews various nanofabrication techniques for fabrication of nanostructures in general and nano dot arrays in particular. Especially, in fabrication of an ordered nano dot array on a plastic film, these conventional nanofabrication techniques suffer from many limitations such as high cost, stringent in operation, or difficulty in controlling the uniformity and regularity of nano dot array. With the aim to overcome these limitations and disadvantages, a new process for fabrication of an ordered nano dot array on a plastic film by the combination process of nano-plastic forming, thermal dewetting, and dot transfer technique is proposed in this research work.

Chapter 3 – FABRICATION OF A RANDOM NANO DOT ARRAY ON A PLASTIC FILM: In order to study the optical properties of gold nano dots and dot transfer mechanism, the process for fabrication of a random metallic nano dot array on a plastic film was first

examined. The experimental procedures are as follows: (1) a quartz glass substrate or a silicon substrate is deposited with a thin layer metal; (2) The metal deposited substrate is then subjected to thermal dewetting process to cause the aggregation of the metallic deposited layer into a random nano dot array; and (3) finally, the random nano dot array is transferred to a plastic film. The effects of process condition on the morphology, on the optical property of nano dot array, and on the transfer ratio of a nano dot array from a substrate to a plastic film are studied.

The experimental results show that the morphology of random nano dot array strongly depends on the annealing temperature, annealing time, substrate material, and gold film thickness. Consequently, the morphology of nano dot array strongly influences the absorbance property. It is also found that the process parameters: substrate materials, plastic materials, annealing temperatures significantly affect the transfer ratio of a nano dot array from a substrate to a plastic film. A 20 cm^2 in area of a random nano dot array was successfully fabricated on an Araldite rapid epoxy film. Furthermore, the nano dot transfer mechanism based on the total free energy theory is developed to explain the experimental results.

Chapter 4 – FABRICATION OF AN ORDERED NANO DOT ARRAY ON A PLASTIC FILM: In this chapter, firstly the concept of the process for fabrication of an ordered metallic nano dot array on a plastic film is presented. It consists of four steps; (1) A grid pattern is fabricated on a hard substrate by nano-plastic forming; (2) The patterned substrate is deposited with a thin layer of metal; (3) The metal deposited substrate is then subjected to thermal dewetting process to cause the aggregation of the metallic substrate into an ordered nano dot array; and (4) finally, the ordered nano dot array is transferred to a plastic film. The feasibility of the process is verified through the experiments. In addition, the effects of process conditions on the morphology of the nano dots aggregated on a patterned substrate and transfer of an ordered nano dot array to a plastic film are studied.

The experimental results show that under proper conditions, patterning on a substrate by nano-plastic forming improves the uniformity and regularity of nano dot array through thermal dewetting process. It is found that the uniformity and regularity of nano dot array strongly depends on the gold film thickness, annealing temperature and indentation load. The ordered nano dot array is then transferred to a plastic film to evaluate the feasibility of the process. The results show that ordered nano dot arrays were successfully fabricated on both araldite rapid epoxy film and specifix-20 epoxy film. In addition, the re-usability of the patterned substrate is demonstrated for obtaining high throughput.

Chapter 5 – CONCLUSION: In conclusion, the objective of this research work is achieved. In addition, some suggestions are also discussed for the future study.

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).