# 論文 / 著書情報
# Article / Book Information

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# 論 文 要 旨

THESIS SUMMARY

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| 系・コース：<br>Department of, Graduate major in | 機械 系<br>機械 コース | 申請学位（専攻分野）：<br>Academic Degree Requested | 博士 （ 工学 ）<br>Doctor of |
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）


An efficient, inexpensive fabrication method for metallic micro/nano structures has been proposed and studied. The feasibility of the process has been demonstrated. The proposed fabrication procedure has mainly three steps:

1. Ultraprecision machining
2. Replication molding
3. Cold-welding transfer printing

The important findings are listed as follows.

1) The feasibility of fabrication of mother mold with nanometer scale pattern by low-cost ultraprecision machining has been demonstrated. A large-area uniform groove pattern of interval 700 nm was fabricated on the Ni-P substrate utilizing a single crystal diamond cutting tool. The rake angle of the tool was 0°. Water lubrication was found to significantly improve the diamond tool life when the cutting depth was on the nanometer scale. After 7000 cutting strokes under water lubrication, the cutting tool tip was still sharp, and the machined groove pattern was uniform.

2) The replication molding of the polymer was studied to fabricate the polymer stamp. Polymer stamps with various kinds of patterns were fabricated by molding from the mother molds. It was found that the fidelity of the molded pattern was affected by the molding temperature and molding pressure. The defects of the stamp pattern were improved by raising the molding temperature and pressure. The hot embossing process was studied for an efficient molding process. A self-constructed hot embossing setup was developed. The pattern structure on the mother mold was efficiently duplicated to the thermoplastic sheets. The processing time was around 10 minutes.

3) An efficient cold-welding transfer printing process was developed for fabricating metallic micro/nano structures. Large-area Au micro/nano disk pattern was fabricated on the COP substrate by using the PC stamp. A self-constructed cold-welding transfer printing device was developed. The welding pressure can be applied manually and controlled by monitoring the load. The subtractive and additive transfer printing mechanism was studied. The Au donee film and the size of the disk structure thick were found to significantly affect the transfer of the weld Au films. Subtractive transfer occurred when the Au film on the substrate was thin. Additive transfer occurred when the film is thick. An Au nanograting pattern with area size 5 mm*2.1 mm was fabricated. The grating pitch was 700 nm, ridge width was around 300 nm. A repetition subtractive stamping test was conducted for efficiently fabricating the micro/nano structures. It took around 30 seconds for each stamping. A stamp can be used repeatedly up to five times. The fabricated patterns by the first 5 stamping operations were uniform. When the stamping times further increased, the welded multiple Au films on the stamp distorted. Compared to the conventional lithography, the proposed cold-welding transfer printing process can drastically reduce the operation steps and facility cost, which is considered possess great potential for the practical application for the metallic nanostructures.


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。
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