課題番号 : F-18-UT-0139
利用形態 : 技術補助
利用課題名(日本語) : オンチップ可動マイクロロボットスイマーの作製
Program Title (English) : Fabrication of on-chip mobile microrobotic swimmers
利用者名(日本語) : ファン キルギョン
Username (English) : G. Hwang
所属名(日本語) : フランス国立科学研究所
Affiliation (English) : French National Centre for Scientific research (CNRS)
キーワード／Keyword : 成膜・膜堆積

1. 概要(Summary)

The goal was to enable nickel layer deposition by electroplating on the lithographically patterned structures for CNRS-C2N Ph.D student. The processed samples will be tested in the microswimmer experimental system at C2N-CNRS. CNRS-C2N is a French National Research Center situated in south of Paris (Saclay). A 2900m² cleanroom is just constructed. The cleanroom in old campus (Marccousis) was shut down and all the equipments are now under re-installation in the new cleanroom. Considering an urgent process needs during shutdown time, I discussed with Prof. Mita about possible process to realize at VDEC supercleanroom. Consequently, during my short visit to Japan, I passed by VDEC for two days (18-19 February) to conduct a process thanks to the support by Prof. Mita and Ms. Mizushima. The process was conducted together with a cleanroom staff (Ms. Mizushima).

2. 実験(Experimental)

【利用した主な装置】

超高真空蒸着装置(ベルジャー)

形状・膜厚・電気評価装置群 DekTak

高密度汎用スパッタリング装置

ニッケルメッキ装置

【実験方法】

1. Metallic layers (Cr/Au 10/100 nm) deposition system by e-beam evaporation of pre-patterned structures by lithography (lithography was made at C2N-CNRS). The deposition speeds were set around 1nm/s.

2. Cr/Ni (10/1500 nm) Sputtering

As an alternative process to thick metallic layer deposition by electroplating, one of the two prepared samples were made with sputtering.

The process worked but the layer thickness was measured by the DekTak system. The measured thickness was around 100nm which is away thinner than expected (1/15). Increasing RF power could help to improve the resulting deposition thickness. But since due to the limited time of this time, we didn't further go this process but the second sample was also made to go through the e-beam deposition (process 2) and electroplating (process 4).

3. Electroplating system for nickel

Since the sputtering did not work, the remaining process solution is electroplating deposition. So the identically e-beam deposited (process 2) two samples were positioned to the newly built Ni electroplating system. The first test was made onto the Au deposited Si substrate to know the right deposition rates and condition. Ni solution was pre-heated to 55 deg-C and maintained during all the process. Air bubbles were injected to the solution to avoid bubble trap on the sample. The solution was circulated and the agitator was operated around counter electrode (metal plate connected to positive charge electrode). The deposition rate was set around 6.7 nm/s.

3. 結果と考察(Results and Discussion)

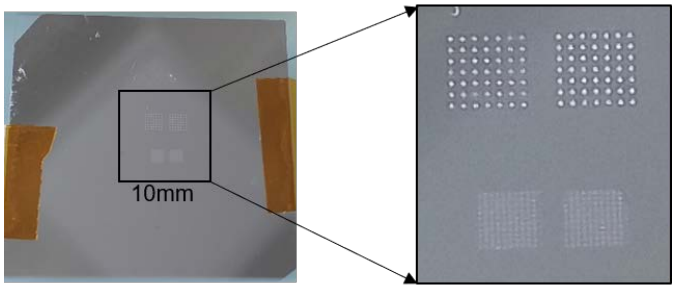

Figure 1. The photograph of the processed samples on glass substrates.

Figure 1 shows the 1.5 um thick Ni layer successfully deposited by the electroplating system. The surface roughness was seen to be highly smooth but further analyses by SEM and AFM will be made at C2N-CNRS.

4. その他・特記事項（Others）

なし。

5. 論文・学会発表（Publication/Presentation）

なし。

6. 関連特許（Patent）

なし。

登録装置名	仕様
高速大面積電子線描画装置	ADVANTEST F5112+VD01
超高速大面積電子線描画装置	ADVANTEST F7000S-VD02
マスク・ウエーハ自動現像装置群	EVG101(現像装置),APTCON(エッチング)、SAMCO FA-1(アッシング)
光リソグラフィ装置 PEM800	UNION PEM800
光リソグラフィ装置 MA-6	Suss MA6
4 インチ高真空 EB 蒸着装置	自作 NSP
ベルジャー蒸着装置	ベルジャー蒸着装置
8 インチ汎用スパッタ装置	ULVAC SIH-450
高密度汎用スパッタリング装置	芝浦 CFS-4ES
金メッキ装置	山本鍍金試験器製
銅メッキ装置	山本鍍金試験器製
超臨界銅成膜装置	自作
高速シリコン深掘りエッチング装置	SPTS MUC-21 ASE-Pegasus
汎用 ICP エッチング装置	ULVAC CE-300I
塩素系 ICP エッチング装置	ULVAC CE-S
汎用高品位 ICP エッチング装置	ULVAC NE-550
汎用平行平板 RIE 装置	SAMCO RIE-10NR
形状・膜厚・電気評価装置群	Keyence, Laser 顕微鏡,DektakXT-S,NanoSpec,Suss8”プローバ、 分光エリプソメーターM-550
機械特性評価装置	Polytec MSA-500
クリーンドラフト潤沢超純水付	ドラフトチャンバー
ステルスダイサー	DFL7340(ステルス・Si 用)
ブレードダイサー	DAD3650
気相フッ酸エッチング装置	IDONUS 8 インチ装置 Vapor HF 専用
マニュアルウエッジボンダー	WestBond 7476D
エポキシダイボンダー	WestBond 7200C
セミオートボールボンダー	WestBond 4700E
精密フリップチップボンダー	Finetech Lambda
電子顕微鏡	Hitachi S－4700 CR 内と 2 号館に各 1 台
SEM	TM-3030Plus
電子線顕微鏡観察用コーター	GATAN 社 PECS
半導体パラメータアナライザー	B1500
イナートガスオーブン	INH-9CD
精密研磨装置	Logitec PM5
川崎ブランチスパッタリング装置	CFS-4EP-LL 芝浦メカトロニクス(株)
川崎ブランチ ECR スパッタリング装置	EIS-230W (株)エリオニクス
川崎ブランチ化合物用エッチング装置	PlasmaPro100-ICP-180 Oxford Instruments
集積回路パターン微細加工(FIB)装置	FEI V400ACE
UV レーザープリント基板加工装置	LPKF ProtoLaser U3
NC プリント基板加工装置	LPKF Protomat S62
高速ランプアニール装置	MS-HP2-9
サンドブラスト	不二製作所