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利用者名(日本語) :ニコラ クレモン, ロラン ジャラベル, 藤井輝夫
Username (English) :N. Clement, L. Jalabert, T. Fujii,
所属名(日本語) :東京大学生産技術研究所・フランス国立科学研究センター集積マイクロメカトロニクスシステム国際共同研究ラボラトリー
Affiliation (English) :LIMMS-CNRS/IIS, The University of Tokyo (CNRS UMI 2820)
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1. 概要(Summary)

金蒸着後、電子ビームリソグラフィとリフトオフプロセスにより 10 nm の金ナノドットを作製した。

2. 実験(Experimental)

【利用した主な装置】 超高速大面積電子線描画装置 F7000S-VD02、8 インチ汎用スパッタ装置

【実験方法】

ナノドットの電子ビーム描画(3～6 時間)、8 nm 金蒸着

3. 結果と考察(Results and Discussion)

We could successfully fabricate 10-15 nm diameter gold nanodots with a combination of e-beam lithography (Advantest F7000-VD02), evaporation and Lift-off process (Fig.1). We aim at patterning arrays of 10nm dots on 4 inch wafer. The process has been adapted from the one described in [1], with the use of 40 nm-thick ZEP instead of PMMA 950K. For such thin ZEP layer, the usual ZEP remover does not provide the optimum result for the lift-off process, so other removers have to be tested. The e-beam Advantest F7000 writing speed for 10 nm-dot arrays is substantially improved compared to results published in [1], thanks to the "on-the-fly" writing ability. This enabled the fabrication of nanodot arrays over several cm^2. However, if we compare to state-of-the-art e-beam writing speed for such nanodot arrays [2], with studies specifically dedicated to that purpose, the actual writing speed remains few times slower. The present limitation is the maximum available beam current density ($100A/cm^2$), which corresponds to 100 pA for a single 10 nm × 10 nm dots, whereas optimized currents for 10 nm × 10 nm dots have been estimated to 1 nA [2]. This could potentially be improved significantly in the future by using additional hard masks that contain the pattern to be exposed.

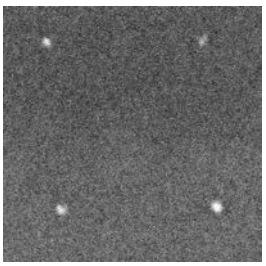

Fig. 1 SEM image of 10 nm diameter dots obtained by e-beam lithography. Interdots spacing is 200 nm.

To conclude, we have shown the possibility to fabricate 10-15 nm diameter dots and identified potential strategies to improve both the homogeneity of the lift-off process and the writing speed of such arrays. In addition, we plan to extend this process to glass substrates towards the development of single-biomolecule sensor arrays.

4. その他・特記事項(Others)

References:

[1] N. Clement, G. Patriarche, K. Smaali, F. Vaurette, K. Nishiguchi, D. Troadec, A. Fujiwara, and D. Vuillaume, Large-array of sub-10 nm single grain Au nanodots for use in Nanotechnology, Small 7, 2607 (2011)

[2] J. Trasobares, D. Vuillaume, D. Theron, and N. Clement, A 17 GHz Molecular Rectifier, Nature Communications, 7, 12850 (2016)

5. 論文・学会発表(Publication/Presentation)

なし

6. 関連特許(Patent)

なし