課題番号 :F-15-AT-0004
利用形態 :機器利用
利用課題名(日本語) :穴あきマーク作製
Program Title (English) :Micro-holes and metal marks for EB lithography
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1. 概要(Summary)

We have been developing standard samples for calibrating the electron beam lithography system, model CABL series. Previously we made some metal samples in AIST, successfully. Remaining problem is the asymmetric observations of the sample due to so-called an edge effect. We have fabricated micro-holes which we can suppress the edge effect. We have observed enhancement of the clear edge profiles.

2. 実験(Experimental)

・Instruments

真空蒸着装置、プラズマ CVD 装置、反応性イオンエッチング装置(RIE)、スターラーウォーターバス

・Experiments

A thin Si wafer made by Chemical Mechanical Polishing is covered with silicon oxide film in plasma CVD in AIST. The total film thickness of 1.5 micrometers is obtained by multi-deposition processes. The thickness is enough against wet-etching. Patterns are exposed by our high resolution electron beam lithography machine CABL-9000C. The surface oxide layer as a mask is patterned by RIE to form a stencil holes. The carbon tetrafluoride etching gas pressure is 10 Pascals, and the flow rate is 10 standard cubic centimeters per minute. The etching rate of oxide is 40 nanometers per minute in a 100 Watts plasma. Si is removed through the stencil in 39 percent potassium hydroxide. The etching rate of Si at 70 degrees Celsius is 0.3 micrometers per minute.

3. 結果と考察(Results and Discussion)

SEM micrographs of the samples are shown in the figure1. A metal mark is shown for comparison. Because of the edge effect, the signal on left panel has a clear peak along the right edge, while there is a very small peak at the edge on right panel. The derivative of the signal can quantify the edge sharpness by fitting a Gaussian function. We obtain the characteristic length of 30 nanometers for the metal mark and 8 nanometers for the micro hole.

We have confirmed the edge is sharper for the micro hole but the overall structure is not very good because of the unintended wet etching. The thermal oxidation is the best method to improve the structure. The more progress is expected.

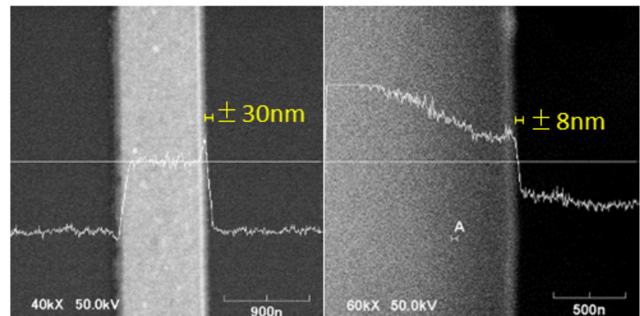

Fig.1 SEM micrographs of samples. Left) Au metal mark. Right) Micro-hole. The solid lines crossing the centers of photographs show line profiles of secondary electron intensity (arb. unit). The edge slope gives the effective beam radius. The slope on right panel is sharper. Notice the magnifications.

4. その他・特記事項(Others)

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5. 論文・学会発表(Publication/Presentation)

なし。

6. 関連特許(Patent)

なし。