Selective growth and micro patterning of $SrRuO_3/Ba_{0.6}Sr_{0.4}TiO_3/SrRuO_3$ hetero-epitaxial grown film capacitor by water lift-off process

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[Introduction]

Regarding the miniaturization and high performance of the devices, the microfabrication technology is increasingly important. Generally, oxide is difficult to be etched. It is not easy to establish industrially suitable processing technology. Meanwhile we have developed the water lift off (WLO) process using deliquescence of amorphous calcium oxide (*a*-CaO) to selectively grow the oxide film at high temperatures. We have reported the micro patterning technology of oxide films using WLO process [1].

In this study, we would like to demonstrate selective growth and micro-patterning of hetero-epitaxial oxide films to create film capacitor structure by WLO process. To do so, we have been preparing the capacitor structures of $SrRuO_3$(SRO)/$Ba_{0.6}Sr_{0.4}TiO_3$ (BST)/SRO film capacitor on (100) $SrTiO_3$ (STO) substrate through WLO process.

[Experimental]

Firstly, photoresist was coated and patterned on the STO substrate by photolithography. Then *a*-CaO film was deposited at room temperature by pulsed laser deposition (PLD) method. After that, *a*-CaO film was patterned by lift-off using acetone solution. The following was deposition of SRO and BST thin films on (100) STO by PLD, then deposited oxide films were patterned by WLO process using ultra-pure water. In this study, SRO top and bottom electrodes and BST films were deposited at 720 and 710 °C respectively.

[Results and discussion]

Figure 1 shows an optical microscope image of prepared film capacitor structure. The *a*-CaO residu was not observed after WLO process. Squared BST films and SRO top and bottom electrodes with size of 20μm in width were successfully created on the STO substrate. This result shows that selective growth of each oxide films can be realized by WLO process.

The crystallinity of the specimen was then characterized using XRD. Figure 2 shows the XRD patterns of the prepared specimen. Although weak peak of (110) orientation of SRO and BST were appeared, highly preferred (100) and (200) orientation of SRO and BST films were observed. The weak peak of (110) orientation of SRO and BST were probably resulted from edge parts of the patterned films. Based on this result, we consider that micro-patterned SRO and BST films have been hetero-epitaxially grown on (100) STO substrate successfully. Our results suggest that WLO process is possible to realize selective and hetero-epitaxial growth of oxide films.

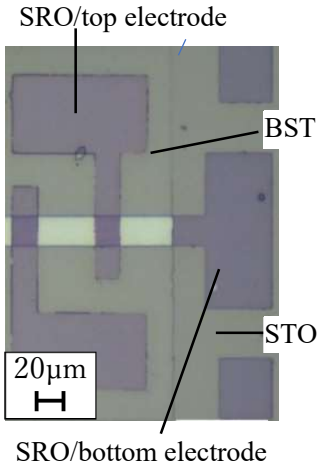

Fig 1. Optical microscopy of film capacitor structure

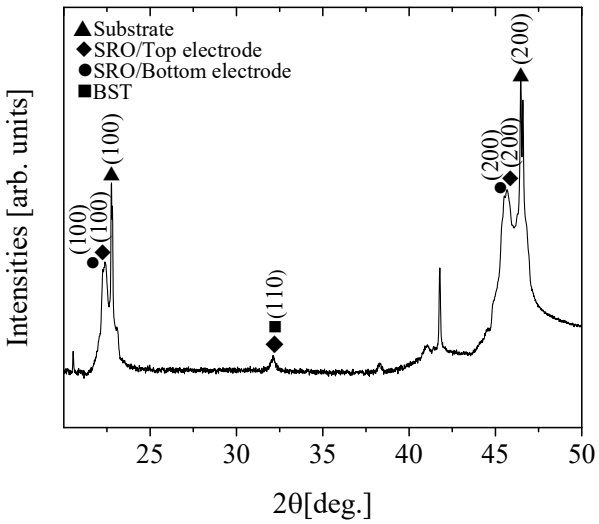

Fig 2. XRD pattern of prepared specimen

[1] T. Kawae *et al*., IUMRS-ICAM 2012, C-3-026-004 (2012)