TixSi1-xO2 deposited by plasma-enhanced atomic layer deposition for spacerapplication

Sanghun Lee [1], Woo-Jae Lee [2], Wontae Noh [3], Satoko Gatineau [3], Se-Hun Kwon [2], and Hyungjun Kim [1]
[1]Yonsei Univ., Korea, Republic of
[2]Pusan National Univ., Korea, Republic of
[3]Air Liquide Laboratories Korea, Korea, Republic of

Thin film grown by AtomicLayer Deposition has been enabled advanced nano-patterning technology such as spacerdefined multiple patterning. The main scheme of this patterning technology isusing sidewall spacer deposited by ALD as a hardmask. However, usually the high aspect ratio and poor mechanical strength of spacersoften causes its collapse problem and this phenomenon was also identified duringmultiple patterning process. Therefore, the studies for spacer materials that have high etchselectivity and good mechanical properties are required, but there is lack ofresearch on it. In this respect, TiO_2 is one of good candidate forspacer materials. Here, we studied on film properties of TiO_2 grown by ALD forspacer materials and further investigations for mixture with SiO_2were followed. We observed growth of $Ti_xSi_{1-x}O_2$(x=0~1) using $Ti(CpMe_5)(OMe)_3$, $Ti(O^iPr)_4$and $H_2Si[N(C_2H_5)_2]_2$ andO_2 gas using PE-ALD at low temperature (100 °C). The chemical composition and carbon impurities of the films wereanalyzed by x-ray photoelectron spectroscopy (XPS), and the nanostructures ofthe films were analyzed by x-ray diffraction (XRD). And mechanical property of$Ti_xSi_{1-x}O_2$ films was investigated bynanoindentation. We compared the etch rate of $Ti_xSi_{1-x}O_2$films using both dry and wet etching process. As a result, we obtained $Ti_xSi_{1-x}O_2$films with various Ti/(Ti+Si) compositions and there was no Ti precursordependency on dry etch rate which decreases as Ti composition increases. However,both pure TiO_2 films were not strippable by diluted HF solution dueto its anatase phase. Furthermore, wet etch rate of mixtures were higher than evenpure SiO_2 film when the films deposited by using $Ti(CpMe_5)(OMe)_3$.