Transmission Electron Microscopy Observation of the Interface between Si Substrate and $PbTiO_3$ Thin Film Deposited by Atmospheric Pressure Metal Organic Chemical Vapor Deposition, Cheol Seong Hwang and Hyeong Joon Kim, Department of Inorganic Materials Engineering, Seoul National University, 151 - 742, Seoul, Korea

The interface between chemically vapor deposited $PbTiO_3$ thin film and Si substrate was investigated by TEM and EDX. $PbTiO_3$ thin films were deposited by metal-organic chemical vapor deposition using Pb-TMHD and Ti-isopropoxide as source materials in a temperature range of 410~500℃ under Ar plus O_2 atmosphere.

During deposition of $PbTiO_3$ thin films on bare Si substrate Pb-silicate layer was produced at the interface between $PbTiO_3$ and substrate due to the diffusion of Pb and O ions into Si substrate irrespective of the deposition conditions. To prevent the unintentional formation of Pb-silicate layer at the interface, several diffusion barrier thin films such as TiO_2, ZrO_2, TiN, and Pt were deposited prior to $PbTiO_3$ deposition and their reactions with Si substrate and $PbTiO_3$ thin film were also investigated. TiO_2 and ZrO_2 films deposited on Si were easily converted to $PbTiO_3$ and $PbZrO_3$, respectively, during the $PbTiO_3$ deposition at a substrate temperature of 410℃ by the reaction with diffusing Pb and O ions. The diffusing Pb and O ions penetrated through the $PbTiO_3$ and $PbZrO_3$ layer into Si substrate and finally produced Pb-silicate layer at the interface. TiN film did not react with Pb during the deposition of $PbTiO_3$, but it reacted with $PbTiO_3$ to form a lead-deficit pyrochlore during post-deposition rapid thermal annealing at 700℃. Pt could be a diffusion barrier, but the surface of $PbTiO_3$ film and the interface between film and substrate became very rough due to the formation of Pt-silicide during deposition.

But Pt thin films deposited on a thermally oxidized Si wafer can act as a good barrier to prevent the reaction between $PbTiO_3$ thin film and Si substrate during deposition and post-RTA at 700℃. Pt surpresses the diffusion of Pb to Si substrate and SiO_2 prevents the formation of Pt-silicide. Therefore, a single phase $PbTiO_3$ thin films can be deposited on $Pt/SiO_2/Si$ substrate at a substrate temperature of as low as 350℃ by MOCVD.

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