High-k TixSi1-xO2 thin films prepared by co-sputtering method

We report on high-k TixSi1-xO2 thin films prepared by RF magnetron co-sputtering using TiO2 and SiO2 targets at room temperature. The TixSi1-xO2 thin films exhibited an amorphous structure with nanocrystalline grains of 3–30 nm having no interfacial layers. The XPS analyses indicate that stoichiometric TiO2 phases in the TixSi1-xO2 films increased due to stronger Ti–O bond with increasing TiO2 RF powers. In addition, the electrical properties of the TixSi1-xO2 films became better with increasing TiO2 RF powers, from which the maximum value of the dielectric constant was estimated to be ~30 for the samples with TiO2 RF powers of 200 and 250 W. The transmittance of the TixSi1-xO2 films was above 95% with optical bandgap energies of 4.1–4.2 eV. These results demonstrate a potential that the TixSi1-xO2 thin films were applied to a high-k gate dielectric in transparent thin film transistors as well as metal-oxide-semiconductor field-effect transistors.

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The XPS analyses provide a more definitive view of the chemical bonding states in the thin films. Fig. 2 shows the XPS spectra of the O 1s core levels for the TixSi1-xO2 thin films deposited with various TiO2 RF powers.
The XPS analyses of the Ti 2p were carried out for the Ti-related bonds on the TixSi1-xO2 thin films deposited with various TiO2 RF powers as shown in Fig. 3.

Keywords
Co-sputtering; High-k dielectric; Chemical bonding state

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