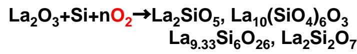
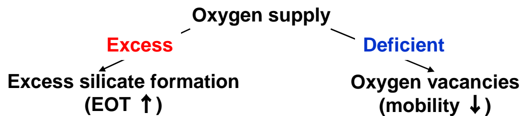
Precise Control of Silicate Reaction with La_2O_3 Gate Dielectrics for EOT of 0.5 nm

D. Kitayama[1], T. Kubota[1], T. Koyanagi[1], K. Kakushima[2], P. Ahmet[1], K. Tsutsui[2], A. Nishiyama[2], N. Sugii[2], K. Natori1, T. Hattori[1] and H. Iwai[1]
Tokyo Tech. FRC[1], Tokyo Tech. IGSSE[2]

Purpose of This Work

La_2O_3 can easily achieve a direct contact of high-k/Si by forming La-silicate





W(60 nm)/La_2O_3(3 nm)/n-Si
Annealing time=30 min
EOT increases due to excess silicate formation
EOT (nm)
Annealing temperature(°C)
Metal
La_2O_3
La-silicate
n-Si
Control the silicate reaction by metal thickness

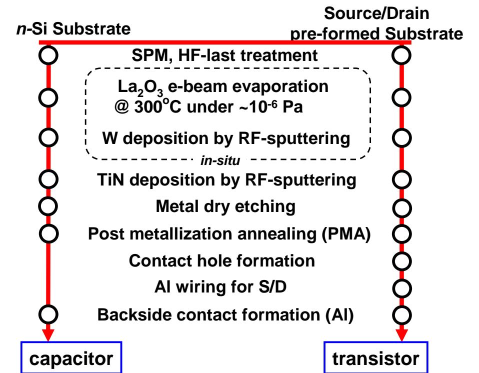
W electrode supplies oxygen to gate dielectric

E. J. Preisler, et al., Appl. Phys. Lett., vol.85, p.6230(2004)

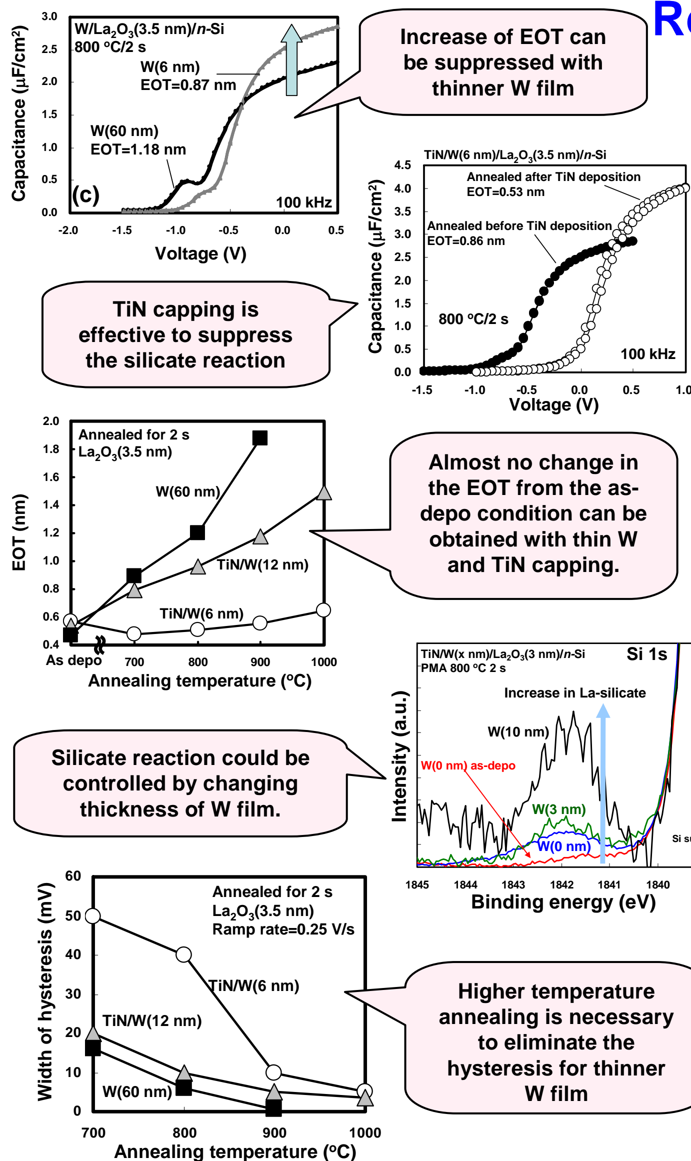
Purpose

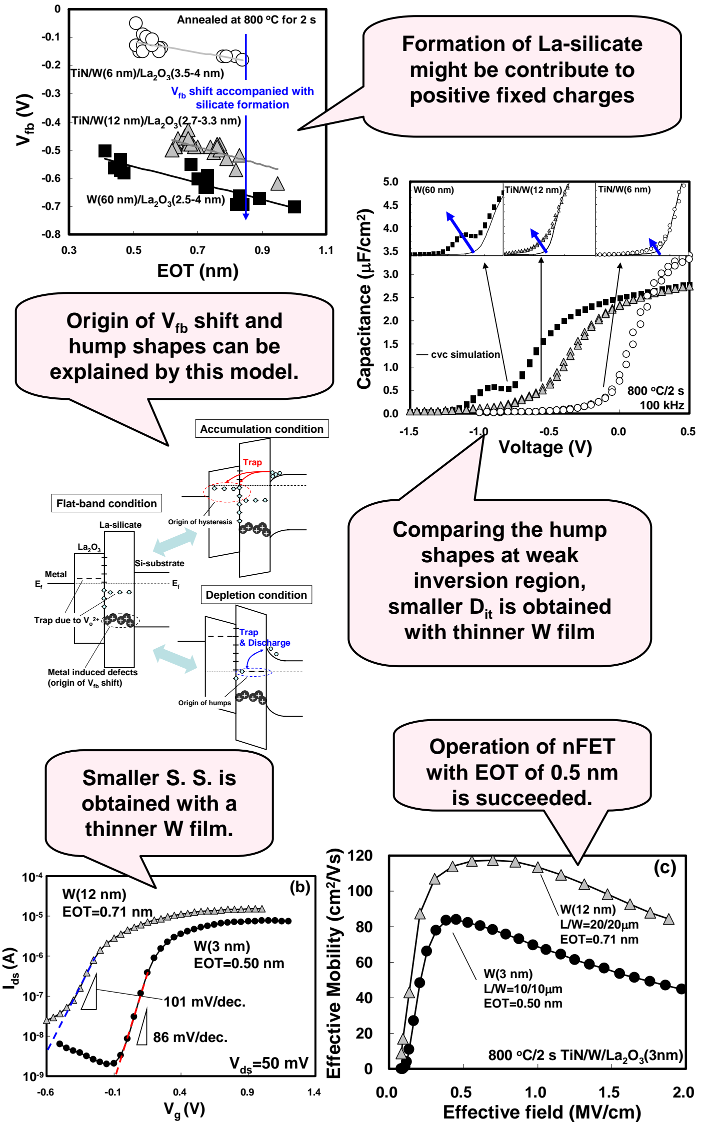
Control the oxygen supply by changing W thickness

Fabrication Process



Results





Conclusion

- Silicate reaction could be controlled by changing thickness of oxygen contained metal.
- A proper transistor operation with small EOT of 0.5 nm has been confirmed.
- Relatively low μ_{eff} must be improved by reduction of fixed charges such as oxygen vacancies or defects induced by metal.