

Plasma Atomic Layer Etching of Ruthenium with Surface Fluorination and Ion Bombardment for Next-generation Interconnect Metal

Yongjae Kim, Hojin Kang, Minsuk Choi, Heeju Ha, and Heeyeop Chae

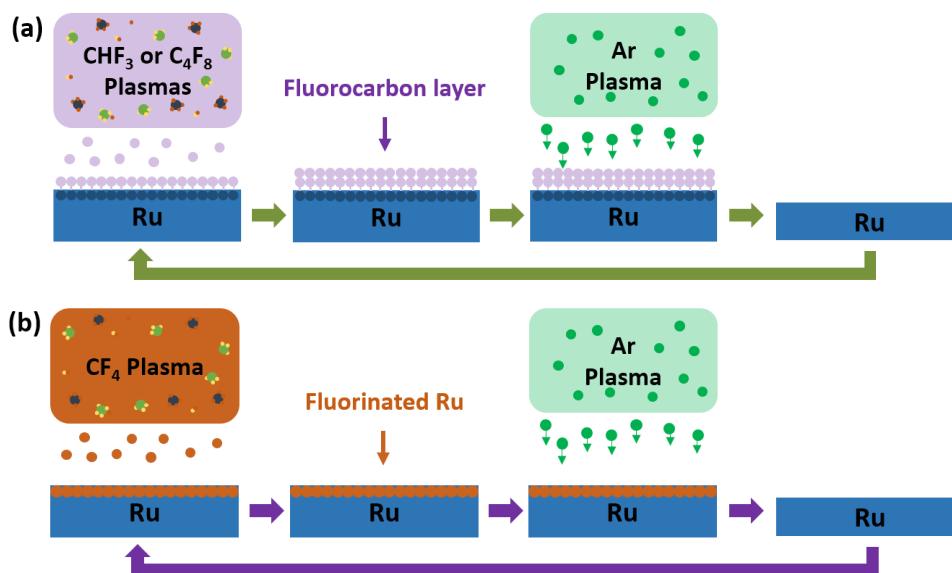


Figure 1. Sequence of the ALE process for Ru with surface fluorination using (a) CHF_3 or C_4F_8 plasmas and Ar ion bombardment and surface fluorination using (b) CF_4 plasma and Ar ion bombardment.

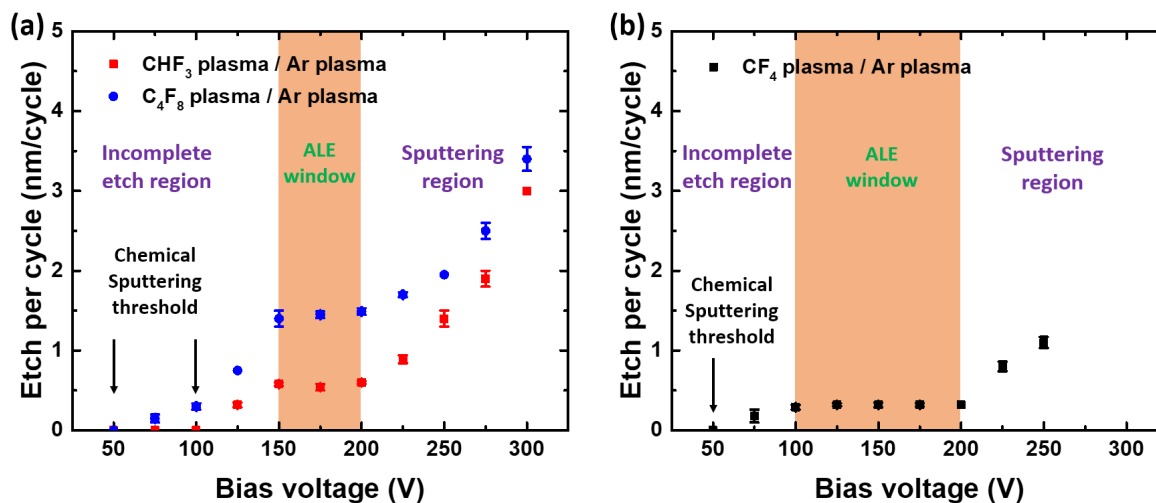


Figure 2. Etch per cycle of Ru with (a) CHF_3 or C_4F_8 plasmas in the surface fluorination step and (b) CF_4 plasma in the surface fluorination step as a function of Ar plasma bias voltage in the ion bombardment step.