Reducing Aluminum Corrosion after Etching Aluminum using Cl₂ and BCl₃

Introduction: Aluminum corrosion, which is a chemical reaction of the etch by-products, AlCl₃, embedded in the sidewall deposits, with moisture in the air, results in “warm”-like residues, which can be observed under microscope. To reduce this corrosion, one needs to do a following up, in-situ, clean to remove the sidewall deposits, with a small amount of fluorides to convert the corrosive AlCl₃ to non-corrosive AlF₃ and some hydrogen to react with the residual chlorides to volatile HCl.

Experimental:

1) Sample: SiO₂ (~300 nm) patterned Al/Ni/Ti on Si

2) Etch the top Al film using Panasonic ICP#1 with 0.7 Pa, 70/300 W, Cl₂/BCl₃=40/20 sccm, and etch time=80 s.

3) Etch the SiO₂ side-wall deposit with some AlCl₃ embedded, in-situ (the sample was remained inside of the etch chamber after the Al film etching) using Panasonic ICP#1 with 0.5 Pa, 200/900 W, CHF₃=40 sccm (1 pa, 50/900 W, CHF₃=40sccm, and time=300 s for sample#Ti/Ni/Al06-04; 1 pa, 100/900 W, CHF₃=40sccm, and time=300 s for sample#Ti/Ni/Al06-05).

4) Put the etched sample into DI water to remove the remaining Cl₂.
Results:

Figure 1 Sample Ti/Ni/Al#06-03: After the Al-film etch (no the following in-situ CHF$_3$ plasma clean).
Figure 2 Sample#Ti/Ni/Al06-01: After the Al-film etch and the following in-situ CHF<sub>3</sub> plasma clean for 3 minutes.
Figure 3 Sample#Ti/Ni/Al06-02: After the Al-film etch and the following in-situ CHF$_3$ plasma clean for 6 minutes.
Figure 4 Sample#Ti/Ni/Al06-04: After the Al-film etch and the following in-situ CHF₃ plasma clean (1 Pa, 50/900 W, CHF₃=40sccm) for 5 minutes.
Figure 4 Sample#Ti/Ni/Al06-05: After the Al-film etch and the following in-situ CHF$_3$ plasma clean (1 Pa, 100/900W, CHF$_3$=40sccm) for 5 minutes.