Growth and characterization of Ti-Al-N films prepared by plasma-enhanced atomic layer deposition of TiN and AlN

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Recently, ternary compounds of Ti-X-N films with superior oxidation resistance have been developed and investigated as an alternative to TiN. Of these ternary titanium nitride materials, Ti-Al-N is the best-studied because it shows excellent anti-oxidation properties. In this study we have investigated the Ti-Al-N films deposited by plasma-enhanced atomic layer deposition (PEALD).

Ti-Al-N films were synthesized from $TiCl_4$, $AlCl_3$, NH_3, N_2, Ar, and H_2 at 350℃ using various plasmas. One cycle of Ti-Al-N deposition consisted of AlN and TiN steps, and the Ti-Al-N cycles were then repeated until the desired thickness was obtained. For $Ti_{0.83}Al_{0.17}N$ films, the growth rate was saturated at 0.045 nm/cycle, which made it easy to control the film thickness concisely. $Ti_{0.83}Al_{0.17}N$ films are polycrystalline with a NaCl-type structure [Fig. 1] and good oxidation resistance when O_2 annealed at 650℃ for 30 min. [Fig. 2]

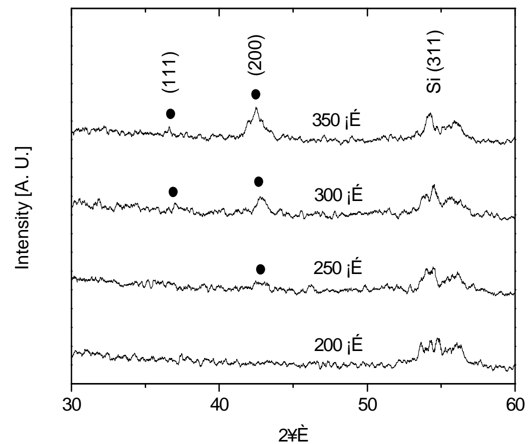

Fig. 1. XRD spectra of $Ti_{0.83}Al_{0.17}N$ films

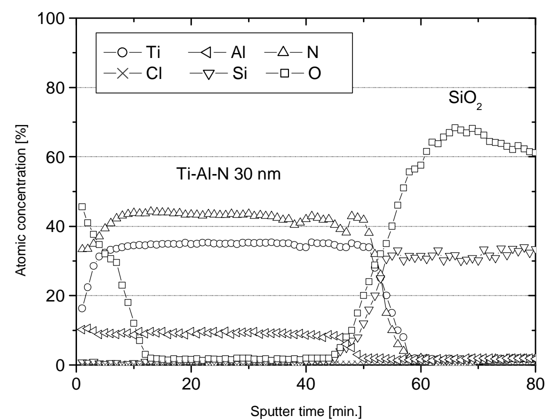

Fig. 2. Anti-oxidation properties of $Ti_{0.83}Al_{0.17}N$ films