RELAXATION OF RESIDUAL STRESSES IN THIN FILMS INVESTIGATED USING SYNCHROTRON RADIATUION

Tatsuya MATSUE[1], Takao HANABUSA[2], Kazuya KUSAKA[2], Osami SAKATA[3]

[1]Niihama National College of Technology

[2]Faculty of Engineering, Tokushima University

[3]Japan Synchrotron Radiation Research Institute/SPring-8

Abstract:

The structure and residual stresses of TiN thin films deposited by arc ion plating (AIP) on a steel substrate were investigated using a synchrotron radiation system that emits ultra-intense X-rays. In a previous study, the crystal structures of TiN films deposited by AIP were found to be strongly influenced by the bias voltage. However, when film thickness were approximately 200-nm, TiN films deposited by bias voltage of –100V and 0V had a preferred orientation of {110}. In this present study, the two-tilt method was used to evaluate the residual stresses in TiN films by measuring lattice strains in two directions determined by the crystal orientation. The TiN films deposited by bias voltage of –100V had the compressive residual stress of -8.0GPa. These residual stresses decreased on increasing the annealing temperature, and it became residual stresses of –3.5GPa in the annealing temperature at 800℃. On the other hand, TiN films deposited by bias voltage of 0V TiN films had the compressive residual stress of –6.5GPa. These residual stresses decreased on increasing the annealing temperature, and it became residual stresses of -5.2GPa in the annealing temperature at 800℃. Residual stresses of bias voltage of –100V/0V double layers film in the {110} oriented layer had the compressive residual stress of –8.5GPa. These residual stresses decreased on increasing the annealing temperature, and it became residual stresses of -5.8GPa in the annealing temperature at 800℃.