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The Structural and Physical Properties of TiOxNy thin films prepared by RF PECVD system

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We have deposited titanium oxynitride (TiOxNy) thin films on Si(100) substrates at 500℃ using capacitively coupled plasma (CCP) type RF PECVD system. Titanium (?) iso-propoxide ($Ti[OCH(CH_3)_2]_4$, 97%) was used as precursor with different nitrogen flow rate to control oxygen and nitrogen contents in the films. FT-IR spectroscopy provided N-H and/or O-H functional groups in the TiOxNy thin films. Changes of chemical states of constituent elements in the deposited films were examined by X-ray photoelectron spectroscopy analysis. With increasing nitrogen flow rate the total amounts of nitrogen and titanium were increased while that of oxygen was decreased. The XPS result also showed a binding energy shift toward high energy side with increasing nitrogen content. The film growth orientation and nanostructural characteristics were also analyzed by X-ray diffraction and scanning electron microscopy as well as transmission electron microscopy. Deposition at higher nitrogen flow rate results in finer clusters with a nano-scalegrain size and a slower growth rate. Nanoindentation experiments showed strong dependency on the composition and nanostructure in the hardness range of 10 and 16 GPa.