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The Study on Synthesis and Characterization of Various Functional Materials by Physical Vapor Deposition and Chemical Vapor Deposition method

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Titanium films were deposited on various substrates, such as pure Si(100), oxide/Si(100) and nitride/Si(100), TiOxNy/Si(100), PI(polyimide), glass, by using r.f. magnetron sputtering. X-ray diffraction (XRD) data showed a distinct change of major film growth direction. In the case of Ti film growth on pure Si(100), oxide/Si(100) and nitride/Si(100) surfaces, the film was strongly grown in the (100) direction while Ti film with highly growth in the (002) direction has been observed on TiOxNy/Si(100), PI and glass surfaces. The surface morphologies were observed with scanning electron microscope (SEM) and atomic force microscopy (AFM). The mechanical properties were also observed by a using nano-indenter. Moreover, We have deposited titanium oxynitride thin films on Si(100) substrates at 500℃ using RF PECVD system. Titanium iso-propoxide was used as precursor with different nitrogen flow rate to control oxygen and nitrogen contents in the 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 nano-structural characteristics were also analyzed by scanning electron microscopy as well as transmission electron microscopy. Deposition at higher nitrogen flow rate results in finer clusters with a nano-scale grain size and a slower growth rate. Nano-indentation experiments showed strong dependency on the composition and nano-structure in the hardness range of 6 and 15 GPa. The film growth orientation and N-H peak intensity characteristics were also analyzed by atomic force microscopy (AFM), and infrared spectroscopy (FT-IR). Through refractive index as well as contact angle analysis, we can suggest that relationship to surface energy and optical property. Moreover, transmission electron microscopy (TEM) was also used to investigate the morphology of TiOxNy thin film and the phase of the TiOxNy thin film different nitrogen flow rate.