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Microstructure and mechanical properties of reactive sputtered nanocrystalline Ti-Al-Ni-N thin films

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Abstract: Nanocrystalline Ti-Al-Ni-N thin films with different Ni content were prepared by sputtering Ti, Al and Ni targets one after the other in N_2 gas atmosphere at 600 ºC and by interdiffusion among Ti, Al and Ni atoms during film deposition. The microstructure and mechanical properties of the deposited films were investigated by field emission scanning electron microscopy, atomic force microscopy, X-ray diffraction, X-ray photoelectron spectroscopy and nanoindenter. The deposited films belonged to B1-NaCl structure, their preferential orientation was (200) plane independent of the Ni content, and the lattice constant reduced with Ni content, showing that solid solution Ti-Al-Ni-N films were formed due to Ti or/and Al atom substitution by smaller Ni atoms during deposition, and crystallite Ni also formed due to the high Ni content. The Ti-Al-Ni-N nanocomposite films were smooth, and their average grain size was about 8 nm, smaller than that of the Ti-Al-N film. The nanohardness and elastic modulus of the Ti-Al-Ni-N films decreased from 33.0 to 12.2 GPa

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