**[MS34 - 05] Thermal stability of metastable fcc-(Ti,Al)N in atoms that should compensate the local lattice nanoscaled TiN/(Ti,Al)N/AlN multilayers strains caused by the fluctuations of the [Ti]/([Ti]+[Al]) ratio. As the central experimental** U. Ratayski [a], M. Motylenko [a], M. Šíma [b], C. methods of the *in situ* microstructure analysis, Baehtz [c], D. Rafaja [a] X-ray reflectivity (XRR) and glancing angle X-ray

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Since the 1980s, titanium aluminium nitride coatings have received a great interest for industrial applications due to their good high-temperature oxidation resistance and high hardness [1, 2]. The oxidation resistance of (Ti,Al)N coatings increases with increasing Al content; their hardness is improved by local strain fields that arise from the local fluctuations of the Ti and Al contents [3, 4]. However, such concentration fluctuations in the (Ti,Al)N coatings with high Al content stimulate the spinodal decomposition of fcc-(Ti,Al)N in Ti-rich fcc-(Ti,Al)N and in nearly Ti-free fcc-(Al,Ti)N that is followed by the transformation of fcc-AlN into the wurtzitic w-AlN and by the degradation of the materials properties. Therefore, new approaches are still sought how to improve the thermal stability of the metastable fcc-(Ti,Al)N by maintaining the local concentration fluctuations. In our study, we regarded the interplay between the thermodynamically driven decomposition of fcc¬(Ti,Al)N and the lattice strains caused both by the residual stresses and by the lattice misfit between the decomposed counterparts to be one of the possible factors influencing the decomposition process. In order to be able to describe this interplay quantitatively, TiN/(Ti,Al)N/AlN multilayers with the repetition length of approx. 12 to 15 nm and with the mean [Ti]/([Ti]+[Al]) ratio of approx. 0.7 were deposited using cathodic arc evaporation and investigated in situ at elevated temperatures up to 950°C. The aim of these studies was to visualize the redistribution of Ti and Al diffraction (GAXRD) were employed. XRR revealed the thickness of the periodic motifs and the thicknesses of individual layers with different densities and thus with different chemical compositions. GAXRD was used to determine the residual stress and the stress-free lattice parameters, and to identify the presence of w-AlN. The in situ experiments were complemented by high-resolution TEM and by scanning TEM with EDX to visualise the morphology of the interfaces and the shape of the concentration profiles. The results of our experiments confirmed the anticipated interplay between the lattice strains and the spinodal decomposition. The as-deposited multilayers consisted solely of face-centred cubic phases with different Ti and Al contents. No w-AlN was detected. During the annealing of 850°C, both the thickness of the fcc-AlN layers and the stress-free lattice parameter of fcc-(Ti,Al)N were reduced that indicates interdiffusion of Al and Ti between fcc-AlN and fcc-(Ti,Al)N, and the levelling of the original concentration profiles. Concurrently, the residual stress in fcc-(Ti,Al)N decreased from about -9 GPa to -5 GPa. Furthermore, the redistribution of Al inhibited the formation of w-AlN. The annealing over 850°C and subsequent cooling to room temperature led to the segregation of Al and Ti.

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