Nb-Zr-O films deposited by reactive sputtering by dual magnetron

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Nb-Zr-O is an attractive material for its potential to become a candidate for protective coating applications where unique multifunctional properties such as sufficiently high hardness with preservation of its elastic properties, i.e. resistance to cracking is required. At the same time, these materials, when optimized regarding their elemental composition and prepared at highly non-equilibrium conditions giving rise to non-equilibrium phase composition with tunable microstructure, can work and keep their properties also at elevated temperatures. This makes them usable as protective coatings in harsh environments. For this particular study, we deposited films by reactive sputtering utilizing a dual magnetron with a closed magnetic field, equipped with Nb targets Ø = 50 mm and with an external fixation ring of Zr in a mixture of sputtering gases Ar + O_2. Magnetrons were tilted 20° to the vertical axis and powered by an Advanced Energy Pinnacle Plus + 5/5 kW power supply operating in a dual cathode mode. As a substrate we used Si wafers, Si (100) strips and Mo plates. Si substrates were used for XRD analysis and macrostress measurements. Mo plates were used to evaluate the cracking resistance of the film in bending. Substrate holder was kept at a floating potential.

In the presented study we will show and explain relations between preparation conditions and obtained properties of the films such as elemental composition, hardness, effective Young's modulus, microstructure, resistance to cracking and thermal stability.