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**High-rate reactive high-power impulse magnetron sputtering of Hf-O-N films with tunable composition and properties**

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High-power impulse magnetron sputtering with a pulsed reactive gas flow control [1, 2] was used for reactive depositions of Hf-O-N films with tunable composition and properties. The depositions were performed using a strongly unbalanced magnetron with a planar hafnium target of 100 mm diameter in argon-oxygen-nitrogen gas mixtures at the argon pressure of 2 Pa. The nitrogen fractions in the reactive gas flow were in the range from 0 to 100%. The repetition frequency was 500 Hz at a fixed deposition-averaged target power density of  $30 \text{ Wcm}^{-2}$  with the duty cycle of 10%. The substrate temperatures were less than  $140^\circ\text{C}$  during the depositions of films on a floating substrate at the distance of 100 mm from the target. A pulsed reactive gas ( $\text{O}_2$  and  $\text{N}_2$ ) flow control made it possible to produce high-quality Hf-O-N films of various elemental compositions with high deposition rates of 175 - 240 nm/min. All films were nanocrystalline and their elemental compositions were varied gradually from  $\text{HfO}_2$  to HfN. We present the gradual change of hard (18 GPa), highly optically transparent (extinction coefficient of  $5 \times 10^{-4}$  at 550 nm) and hydrophobic (water droplet contact angle of  $101^\circ$ )  $\text{HfO}_2$  films into harder (25 GPa), opaque and more hydrophobic (water droplet contact angle of  $107^\circ$ ) HfN films.

[1] J. Rezek, J. Viček, J. Houška, R. Čerstvý, High-rate reactive high-power impulse magnetron sputtering of Ta-O-N films with tunable composition and properties, *Thin Solid Films* 566 (2014) 70–77.

[2] J. Viček, A. Belosludtsev, J. Rezek, J. Houška, J. Čapek, R. Čerstvý, S. Haviar, High-rate reactive high-power impulse magnetron sputtering of hard and optically transparent  $\text{HfO}_2$  films, *Surf. Coat. Technol.* (2015), doi:10.1016/j.surfcoat.2015.08.024)

**Keywords**

Reactive HiPIMS

Pulsed reactive gas flow control

Hf-O-N films

Tunable properties