STUDY OF ALD GROWN MULTILAYERS EXHIBITING VACANCY INDUCED CONDUCTIVITY FOR ELECTRON EMITTERS

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Thin oxide multilayers are prepared using low-temperature atomic layer deposition (ALD) and subsequent thermal recrystallization. The tungsten samples are coated with a multilayer of refractory oxides, Al_2O_3 and TiO_2, and others. This multilayer oxide layer serves as an additional potential barrier within the metal-vacuum interface. The properties of the oxide multilayer are controlled by the number of growth cycles, which affects the thickness of individual layers. The other parameter is the deposition temperature and the post-deposition recrystallization treatment, which affect the crystallinity of grown layers. The purity of the precursors and contaminants present in the ALD chamber also affects the properties of the final multilayer. Ultimately, tuning of those parameters result in the oxygen vacancy-induced conductivity along the interface between the layer of Al_2O_3 and TiO_2 [1]. The structure and crystallinity of the grown multilayers are studied by scanning transmission electron microscopy. Experimental emitters with multilayers are tested in an ultra-high vacuum field emission chamber operating in ~10^{-7} Pa [2].

References

[1] SEOK, T. J., Y. LIU, H. J. JUNG, et al. 2018. Field-Effect Device Using Quasi-Two-Dimensional Electron Gas in Mass-Producible Atomic-Layer-Deposited Al2O3/TiO2 Ultrathin (<10 nm) Film Heterostructures. *ACS Nano*. **12**(10), 10403-10409.

[2] KNAPEK, A., M. HORACEK, F. HRUBY, J. SIKULA, T. KUPAROWITZ and D. SOBOLA. 2017. Noise behaviour of field emission cathode based on lead pencil graphite. In: *2017 30th International Vacuum Nanoelectronics Conference (IVNC)*. IEEE, p. 274-275.