

Accepted Manuscript

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PII: S0040-6090(18)30640-0
DOI: doi:[10.1016/j.tsf.2018.09.041](https://doi.org/10.1016/j.tsf.2018.09.041)
Reference: TSF 36903
To appear in: *Thin Solid Films*
Received date: 11 January 2017
Revised date: 14 September 2018
Accepted date: 20 September 2018

Please cite this article as: A. Guglya, A. Kalchenko, E. Solopikhina, V. Voyevodin, R. Vasilenko, V. Vlasov, E. Lyubchenko, Structure of nanoporous VN_x thin films obtained by ion-beam assisted deposition technology. *Tsf* (2018), doi:[10.1016/j.tsf.2018.09.041](https://doi.org/10.1016/j.tsf.2018.09.041)

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Structure of nanoporous VN_x thin films obtained by ion-beam assisted deposition technology

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Abstract. Nanocrystalline porous VN_x films obtained by ion-beam assisted deposition of vanadium on silicon substrates were investigated in this work. The influence of deposition time and film thickness on the regularities of the formation of nanoporosity was studied by means of high-resolution electron microscopy. It is shown that the combined effect of radiation defects and gas impurities leads to the formation of an open intergranular nanoporosity. VN_x films comprise 150-250 nm-particles separated by porous boundaries 4-8 nm thick. The nanoparticles, in turn, are composed of 15-20 nm-grains. The structure, composition and formation mechanism of the mixing zones were also studied. It was revealed that these non-uniform zones contain areas of vanadium and silicon nitrides with different types of structure. According to the Rutherford backscattering data and profilometry measurements, VN_x film porosity was 27%. Due to its structural features, the thin films obtained by ion-beam assisted deposition can be considered as a promising material for hydrogen storage.

Keywords

Ion-beam assisted deposition; Transmission electron microscopy, High-resolution electron microscopy; Scanning electron microscopy; Vanadium nitride; Nanocrystalline film; Nanoporous structure

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