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The influence of the deposition conditions on the properties of WS2 nanocoatings

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Uniform growth of pristine two dimensional (2D) materials over large areas at low temperatures without sacrifice of their unique physical properties is a critical pre-requisite for seamless integration of nanodevices. WS_2 is well known as a low friction material and most recently, as potential semiconducting material for 2D nanoelectronic devices.
In this work WS_2 coatings were deposited by Physical Vapor Deposition, with different conditions to obtain the highest S/W ratio and the preferential orientation of the basal planes (002) parallel to the substrate. The coatings were deposited with different power applied from 100 to 900 W, the Ar pressure was set to 1.7 Pa and deposited with and without rotation of the substrate. At this stage, the thickness was set to be at least 1 micron to be able to characterize the coatings by X ray diffraction and SEM-EDS. The decrease of the power leads to an increase of the S/W ratio with a maximum value of 1.6 for the coatings deposited with 200W with rotation of the substrates which also contributes to its increase. With this conditions the coatings were deposited with a deposition rate of 30 nm/min.
A set of coatings with the optimized conditions were deposited with decreasing thickness from 1000 to 30 nm. The coatings roughness Ra obtained by AFM increases with the increase of the thickness with a nonlinear growth. The coatings with a thickness higher than 250 nm presents a surface morphology with valleys oriented in one direction related with the shadowing effect due to the rotation of the substrates. The coating deposited with 30 nm presents on TEM images in plan view grains of approximately 5×20 nm with the basal planes (002) oriented in the longest dimension perpendicular to the substrate.

Keywords
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