Design of tungsten oxide nanoparticles and application to electrochemical devices

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Within inorganic semiconductors, tungsten oxide (WO_3) is known to have remarkable electrochromic properties and is nowadays the most widely used material for smart-windows. Nevertheless, due to its low cost and availability, improved stability, morphologic and structural control of thin films and nanostructures, high sensitivity, selectivity and biocompatibility WO_3 is a very promising material regarding other applications in electronics and electrochemistry such as gas sensing in single electron transistors, sensitive layer in ion-sensitive field-effect transistors (ISFETs) or even as high-κ dielectric in transparent TFTs.
The deposition of WO_3 thin films can be done using conventional PVD techniques or solution base ones. The last are particularly interesting since they are more versatile in obtaining nanostructured layers that have advantages compared with the bulk material, such as large fraction of surface atoms, high surface energy, strong surface adsorption and increased surface to volume ratio. Moreover solution based techniques allows also for additive deposition using ink jet or screen printing
In this work we show that WO_3 nanostructured printed films with controllable dual phase (amorphous matrix with embedded nanoparticles) can be obtained in order to optimize the performance of electrochromic devices. The dual-phase films with *a*-WO_3/*ortho*-$WO_3.0.33H_2O$ show an optical density 80% higher than amorphous ones, also with improved coloration efficiency.
WO_3 nanoparticles can also be used to fabricate pH sensors. These sensors show a sensitivity of 56.7 ± 1.33 mV/pH, in the pH range of 9 to 5. A good balance between the performance parameters (sensitivity), the production costs and simplicity of the sensors was accomplished, as requested for wearable biomedical devices.