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Surface nanostructuring using an atmospheric pressure remote micro-plasma

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Nanostructured materials have attracted growing attention due to their unique properties and potential applications. Plasma-assisted nanofabrication is one of the rapidly emerging methods used for the production of various nanostructured materials and elements of nanodevices. In this work, we present results obtained from an atmospheric pressure Ar – O_2 micro-afterglow operating at high temperature [1].
The possibility to synthesise directly metal oxide nanostructures has been studied. This approach consists in exposing metal samples (iron, copper, aluminium, zinc, ruthenium, vanadium ...) to the micro-afterglow. This leads to the synthesis of various nanostructures (nanowires, nanograins, nanowalls...) in a single treatment step by local selective oxidation. The morphology, shape and size distribution can be controlled by varying the experimental parameters. Although the micro-afterglow operates at high temperature (1000 - 2000 K), the sample surface remains at moderate-temperature during treatment (~ 500 - 700 K). This flexible process can be used to synthesize a wide range of nanostructured metal-oxide materials with complex morphologies, which are promising for many advanced applications as semiconductors, electrode materials or solar energy transformation. Moreover, silica nanowires can grow locally on metal films deposited on silicon substrate under specific conditions.
Several techniques were performed to analyse these structures including Scanning Electron Microscopy, X-Ray Diffraction, Transmission Electron Microscopy and X-ray Photoelectron Spectroscopy. It turns out that the growth mechanism of these nanostructures is strongly driven by the development of stress between the oxide layer and the underlying metal.
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