Plasma-surface interactions during Vanadium Oxide (V_2O_3) ThinFilms Etching Process in Fluorine-Based Plasmas.

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Vanadium Oxides have gathered particular interest over the past three decades for their diverse applications as thermal insulators for smart windows [1], catalysts to facilitate oxidation reactions [2], supercapacitors [3], memory devices [4], and neuromorphic networks for the microelectronics industry. For the latter two, controlling and understanding the manufacturing process is crucial to ensure optimum and reliable performances of the targeted microelectronic devices. In particular, the etching processes using cold plasma, also called Reactive Ion Etching, are critical steps to downsize the material for its functionalization into a given device while maintaining the properties observed at the macroscale. TheseRIE processes must ensure compliance with the critical dimension of the pattern and limit the introduction of structural or chemical defects that could impede the performance or lead to a breakdownof the device.

In the case of vanadium oxides, most of the existing etching processes are wet etching [5,6] and RIE reports are scarce [7,8]. Thus, for microelectronics applications, many open questions still have to be addressed: which plasma chemistry to use to ensure the formation of volatile products, and for which plasma conditions? What plasma-surface interaction mechanisms are involved? The present work tries to answer these questions and consists of a joint investigation of the plasma characteristics and surfaceproperties of vanadium oxide during and after RIE. To address these challenges, we first focused on the plasma-surface interactions during the vanadium oxide thin film etching process in fluorine-based plasma. Plasma diagnostics tools such as the Langmuir probe and Optical Emission Spectroscopy (OES) have been used to understand the plasma discharge. *In-situ* and *ex-situ* surface analysis such as X-ray Photoelectron Spectroscopy (XPS), Atomic Force Microscopy (AFM) and Scanning Electron Microscopy (SEM) with Energy Dispersive X-ray spectroscopy (EDX) have been used to investigate V_2O_3 surface morphology and composition before and after RIE processes.

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