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Deposition of Oxyfluoride Thin Films by Cold Plasma Process for the Energy and Environment Domain

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Thin films are important because they offer the potential for low-cost processing with minimal material usage while fulfilling application requirements. One of the most significant applications is the production of renewable energy such as solar energy conversion and water splitting (photocatalysis). Recently, layered bismuth oxyhalides BiOX (X: Cl, Br, I, F), a family of semiconductor photocatalyst materials had attracted significant interest for use in environmental remediation. Compared to the other bismuth oxyhalides, BiOF had been scarcely reported. Therefore, our challenge is to master the synthesis of oxyfluoride thin films by sputtering bismuth target in $Ar/O_2/CF_4$ radiofrequency magnetron plasmas. By plasma sputtering, interesting materials are obtained due to the possibility of tailoring their optical and electrical properties by changing the stoichiometry of the deposit. However, the major disadvantage during the reactive sputtering process is due to target poisoning. Hence, in a first step, the reactivity of oxygen and fluorine gas on the bismuth target as well as the change from elemental to compound sputtering mode were studied by optical emission spectroscopy which is a powerful technique to study the composition of the sputtering atmosphere. Nature of bonds between Bismuth and other elements have been determined from different techniques (IR and Raman spectroscopies, XPS) whereas the elemental composition was confirmed by Rutherford backscattering spectroscopy (RBS). Moreover, the optical properties, such as the refractive indices and the optical band gap, were deduced from UV-visible spectroscopy and ellipsometry. Finally, to go further, the photocatalytic activity of the deposited films will be presented upon degrading universal organic pollutants.

Keywords
reactive sputtering
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