Université
franco-allemande
Deutsch-Französische
Hochschule

Abstract

In this work, the influence of Al (Aluminum) dopant concentration on the properties of Al-doped ZnO (AZO) films synthesized by reactive High Power Impulse Magnetron Sputtering (HiPIMS), and deposited from Zn/Al targets with 1, 2, 5, 10 or 15 at.% Al is studied. It is observed that the Al content has a strong influence on the reactive sputtering process, as it is easier to sputter-deposit at high rates from targets containing lower Al contents. This is explained by the high reactivity of Al towards oxygen, which easily poisons the target surface with Al oxide more difficult to etch upon bombardment by ions from the plasma phase. Films have been synthesized in the 0.56-14.71 at.% Al range, where the film structure and microstructure evolves from nanocrystalline columnar films towards ultrafine nanocrystalline films of wurtzite ZnO structure upon increasing the Al content. The electrical properties revealed that effective doping may be achieved up to 3 at.% Al by using HiPIMS. And most importantly, it is found that electronic structure measurements contain signatures of dopant activation and segregation that may serve to investigate on the origin of electrical properties degradation and to optimize the electrical properties of AZO films. Finally, flat or structured glass/AZO/ZnO/Cu_2O/Au thin film stacks were made. The patterning was done by ultrashort pulsed direct laser interference patterning, and the morphology and microstructure are presented together with possible strategies to improve the preliminary electrical results.