Conclusion

Current Status and Perspectives for Chrome-Doped TiO_2 Thin Films

During this work we were interested in the development, characterization and application of titanium dioxide thin films doped with Cr (TiO_2–Cr) obtained by sputtering. A detailed study was made on the effect of heat treatment and the Cr incorporation on the microstructural and optoelectronic properties of the realized layers. A parametric study was undertaken in order to get a finely control of the different properties for the developed films. Thus the influence of the deposition parameters (Cr concentration, effect of deposition temperature, development time, power) were closely correlated to the microstructural, optical and electrical characteristics.

Furthermore, the analysis of the microstructural and optical properties of the Cr doped and non-doped TiO_2 thin films, shown that titanium dioxide films crystallize in two phases, rutile and anatase, at an annealing temperature of 550 °C. The anatase-rutile phase change takes place for a Cr doping of 7 % and an annealing temperature of 550 °C; the rutile phase (more stable) is achieved at temperatures over 700 °C.

The elaborated layers have been incorporated in a gas sensors structure and a photovoltaic structure. We have shown that the sensors are fairly stable, and TiO_2 film doped with Cr (4 %) presents the best response to ethanol. Furthermore, at 0.1 % ethanol, a maximum sensitivity is reached for an operating temperature of 200 °C. It has been also shown that titanium dioxide obtained by sputtering and deposited on porous silicon substrates formed initially from monocrystalline and multicrystalline substrates can contribute effectively to the reduction of reflection losses. The deposition of a Cr doped TiO_2 film on PS enhances the diffusion length and lifetime of the silicon substrate.

A. Hajjaji et al., *Chromium Doped TiO_2 Sputtered Thin Films*,
SpringerBriefs in Manufacturing and Surface Engineering,
DOI 10.1007/978-3-319-13353-9

In conclusion, this study shows that Cr-doped TiO_2 films combined with porous Silicon is a treatment capable of improving mono and multicrystalline Si optoelectronic properties. A dramatic increase in the lifetime of the multicrystalline Si equal to 733 μs was reached. The experimental results suggest that the TiO_2–Cr/PS induces a good multicrystalline and monocrystalline silicon surface passivation.

As perspective for this work, we suggest the deposition of ohmic contacts on different layers of the Cr-doped titanium dioxide and study of the optoelectronic properties such as quantum efficiency and the photo-courant. Other possibilities would be to improve the electrical properties of these layers by the introduction of other dopants (Pt, Fe,…) and check their use in pollution sensors.