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Effect of Doping with Niobium on the Properties of Titanium Dioxide Thin FilmsPrepared by Sol Gel (Spin-coating) Process

Djehiche Nour el houda[1]*, Saidi Hnane[1] and Attaf Abdallah[1]

Physics of thin films and applications (LPCMA) university of Biskra Algeria

*Corresponding author

ABSTRACT

In this study we deposited undoped and Niobium doped Titanium Dioxide thin films with doping percent varied between (0% -10%) onto glass substrates by Sol-Gel spin-coating method. The films were analysed by the X-Rays diffraction (XRD), UV-Visible spectroscopy. The results obtained by the XRD showed that the prepared films are polycrystalline Titanium Dioxide witha tetragonale structure of anatase. The preferential orientation is (101). The UV-Visible spectrum indicated that the transmission of the films in the visible is about 90%.

Keywords: Thin fims, Titanium Dioxide, Sol Gel (spin-coating), Niobium Doping.

Introduction

The study of matters in the form of thin films has been the subject of a growing number of studies since the second half of the 20th century due to advances technological in the development and the characterizationof these layers. TCO materials are increasingly used in new applications and occupy an increasingly important place in our lives. They are at the base of a new scientific and technological revolution [1]. Among the TCO, Titanium Oxide TiO_2 has an interesting properties (high chemical stability, high refractive index and transparency in the visible) that allow to use it in several applications[2].

Experimental/Theoretical Study

The Sol-Gel process is based on the conversion of a liquid into a solid phase by a series of chemical reactions of the hydrolysis and condensation type of the molecular solution of extreme purity[3]. In all samples, the starting solution contains Titanium Tetraisopropoxide used as dissolved ethanol, with a certain percentage of niobium chloride $NbCl_5$ as a source of doping source. The mixture is stirred by a magnetic stirrer at 50 ° C. The final solutionis transparent yellowish and slightly viscous.

Results and Discussion

1: X.Ray diffraction:

The different peaks characteristic of the TiO_2 structure for different concentrations of Niobium are grouped together in Fig .1

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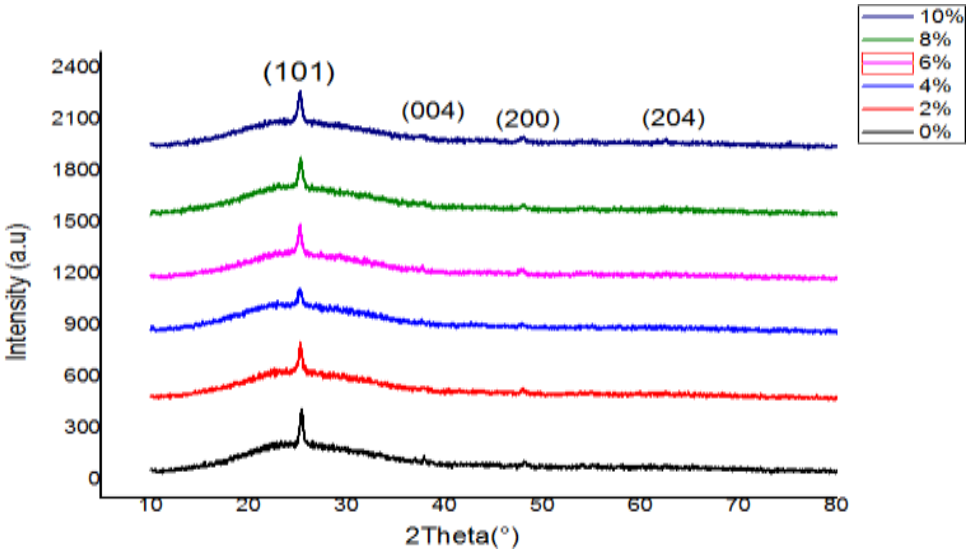

Fig.1: X-Ray diffraction patterns for Nb-doped TiO2 thinfilms

According to the Fig.1we observe a maximum intensityaccording to the plane (101), with the existence of othersecondary peaks according to (004), (204) and (002) which correspond to the phase anatase [4,5].

2: The Optical properties:

The transmittance spectra of our samples areillustrated in the Fig.2:

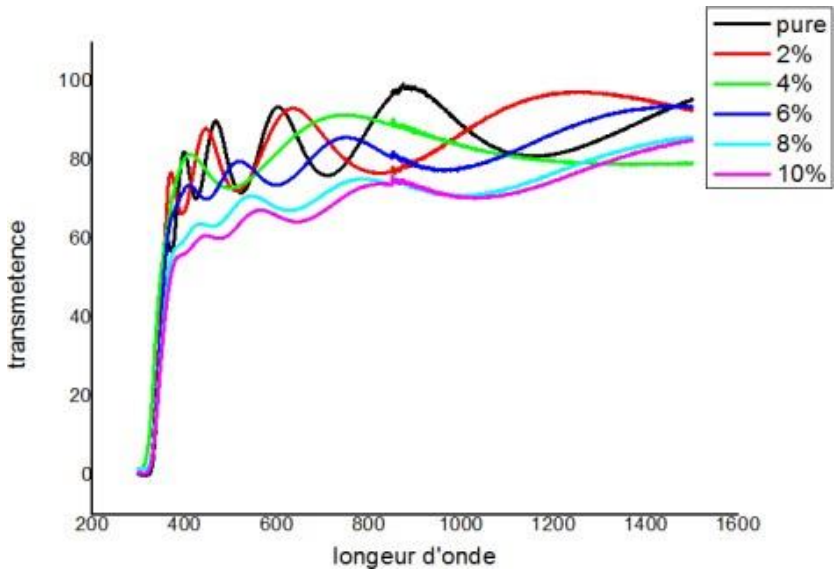

Fig.2: Optical transmittance spectra of TiO_2 thin films.

Transparent zone between 350 nm and 800 nm whichmakes it possible to know the transmittance value in thevisible domain. We note that the transmittance value ofour thin films is varied between 75% and 98%. It is alsoobserved that the transmittance decreases with theincrease of the doping concentration. This decreasecaused by the increase of the absorption due to theincrease of opaque niobium atoms [6].

Conclusion

In this paper we can say that we have succeeded indeveloping thin layers of undoped TiO2 and doped with Niobium by the Sol-Gel technique (spin-coating) with good structural and optical properties

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