Materials: The undoped and Sb doped ZnO films were deposited by sol gel dip coating method onto ITO substrates. The cleaned ITO substrate was placed on the sample holder and was dipped at withdrawn speed of 8 mm/min. The dip coated films were preheated at 300◦C for10 min in a furnace. This coating/drying procedure was repeated ten times, before the films were annealed at 600◦C in air for 60 min.

Results: The crystal quality and orientation of the Sb doped ZnO films were considered by XRD patterns. The presence of several peaks in the XRD reveals that the films are polycrystalline nature with a hexagonal wurtzite structure (JCPDS card file no: 361451). Five main peaks are observed in all the films and the most intense peak belongs to the (002) plane. The crystal quality of the films decreased with the addition of Sb and it causes a decrease in intensity of the peaks.

From this Table, the (002) peak positions of the films shifted toward a lower diffracting angle with increasing Sb doping. Although, no diffraction peaks of Sb or SbO are observed in the XRD patterns, but the presence of Sb2O3phase was confirmed by XPS, the reason of this shifting can be attributed to the fact that the Sb+3ionic radius of 0.78 nm in the ZnO lattice is larger than the Zn+2ionic radius of 0.074 nm, which causes the increase of the inter planar spacing (d) [18,19].These changes in both inter planar spacing and diffracting angle explain the substitution of Sb+3into the Zn site of the host ZnO [20,21]. The crystallite size (D) of undoped and Sb doped ZnO films was determined using the Scherrer's formula [22]and given in Table 1. From this Table, the crystallite size is decreased with Sb doping.

Conclusion: In this study, sol gel dip coating method was used to deposit undoped and Sb doped ZnO films on the ITO substrate. To getp-type ZnO, the small amounts of Sb ratio of 0.2 and 0.4 were used. Sb incorporation caused the occurrence of p-type behavior, but at the same time, it leads to deterioration of crystal structure.

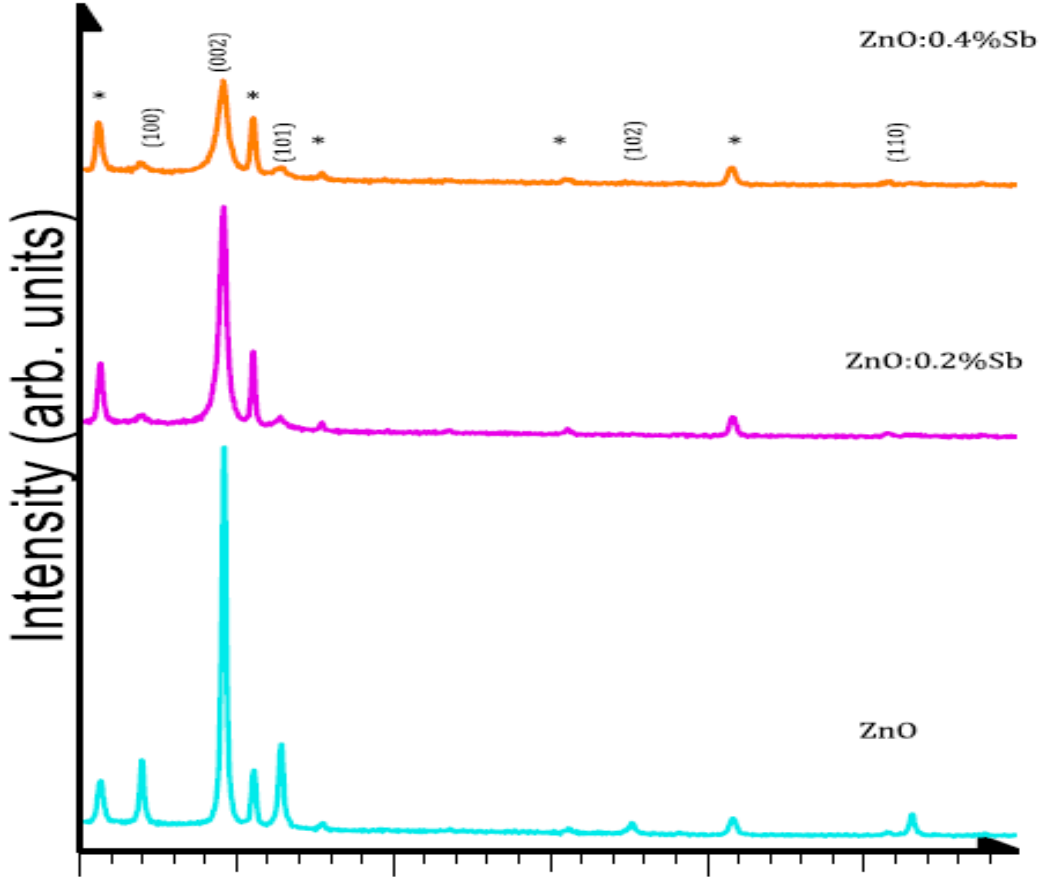

Table 1
Structural parameters of the undoped and Sb-doped ZnO films.

Sample name	(hkl)	2θ (degree)	d (Å)	FWHM (degree)	D (nm)
ZnO	(100)	31.835	2.8070	–	–
	(002)	34.478	2.5976	0.168	48
	(101)	36.317	2.4702	–	–
ZnO:0.2%Sb	(100)	31.813	2.8107	–	–
	(002)	34.447	2.6014	0.260	33
	(101)	36.281	2.4741	–	–
ZnO:0.4%Sb	(100)	31.815	2.8114	–	–
	(002)	34.435	2.6024	0.347	25
	(101)	36.272	2.4746	–	–