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Effect of B2O3 addition on optical and structural properties of TiO2 as a new blocking layer for multiple dye sensitive solar cell application (DSSC)

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Résumé en anglais	TiO2–B2O3 sol–gel films were prepared using titanium(IV) isopropoxide as a Ti source and boric acid (H3BO3) as B precursor. B2O3 doping was found to improve the characteristics of TiO2 films making them suitable to use as blocking TiO2 layers in DSSC B2O3 acted as a flux and glass forming oxide leading to amorphous vitreous layers having an average thickness of 50 nm. Films were transparent, adherent and perfectly continuous without any leakage current. X-ray diffraction measurements prove that crystallinity decreases with boron content meaning that amorphous phase was favoured. Surface morphology was investigated by atomic force microscopy. It showed that film surface became more and more smooth. The Eg Raman-active phonon mode at 145 cm−1 reveals the same arrangement of TiO2 octahedra observed in the anatase phase. The Lorentzian multipeak fitting showed the emergence of a new mode at 152 cm−1 whose mode intensity increased with boron content; we attributed it to the presence of boron. The influence of B2O3 dopant on the optical properties was examined by UV-visible spectroscopy and spectroscopic ellipsometry. Refractive index, extinction coefficient and optical band gap have been extracted by fitting ellipsometric spectra with the double new amorphous model. Difference between the optical gap values obtained from UV-visible spectra and those calculated by ellipsometry did not exceed 0.3 eV. The optical band gap increased from 3.4 to 3.9 eV by increasing boron content from 0 to 20%. The increase of Eg is expected to induce an enhanced output ddp into DSSC.

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