Supplementary Information

Atomic Layer Deposition of B-doped ZnO using Triisopropyl Borate as the Boron Precursor and Comparison with Al-doped ZnO

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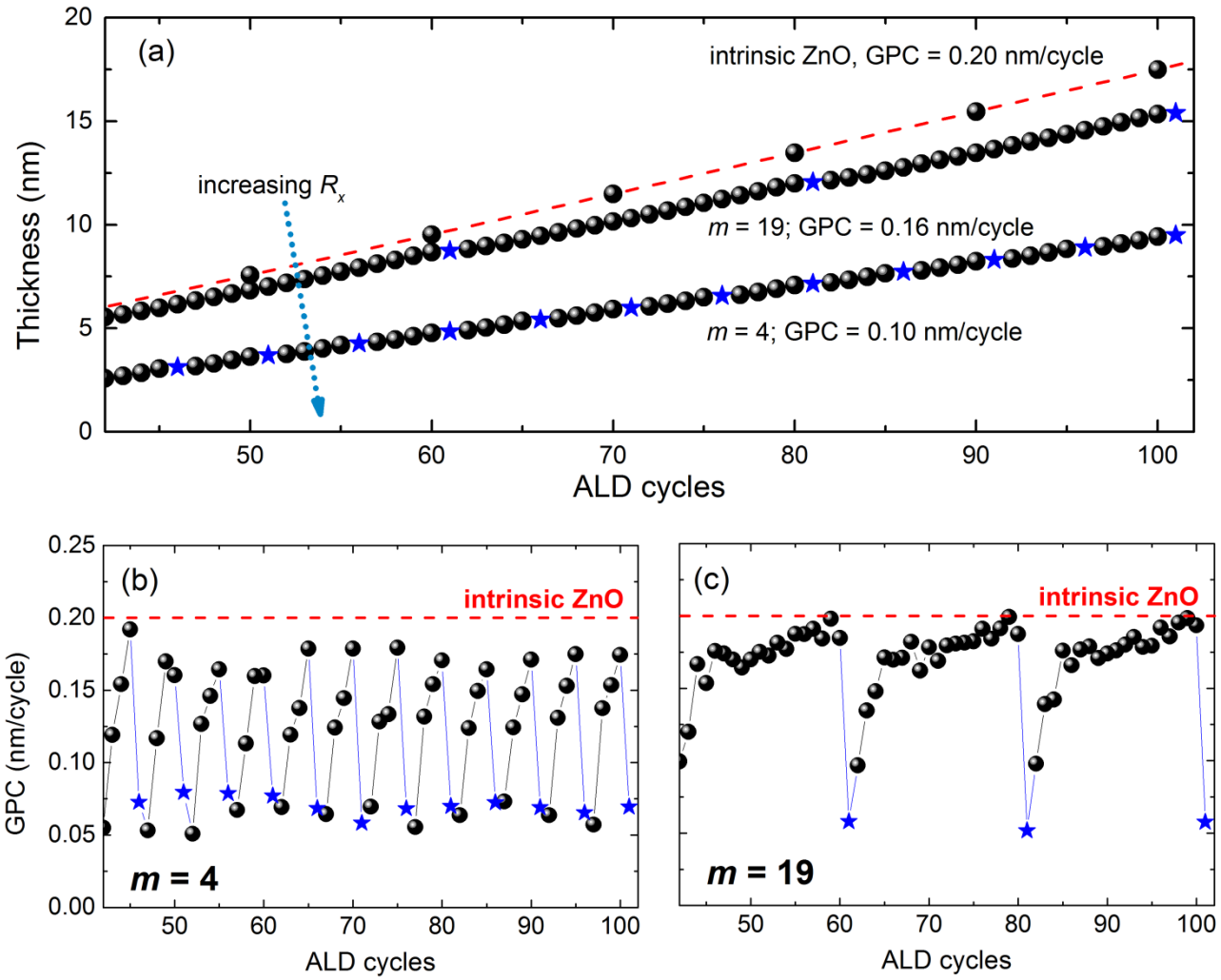

Fig. S1 (a) Thickness of the intrinsic ZnO film and ZnO:B films, where m = 4 and m = 19 for the supercycles, as a function of the number of individual ALD cycles. The dopant ALD cycle fraction, R_x, is defined as 1/(m+1). The change in GPC (nm/cycle) as a function of the number of ALD cycles can be seen in (b) for m = 4 and (c) for m = 19. One spectroscopic ellipsometry (SE) measurement was taken after every individual cycle (DEZ or TIB), where the TIB cycles are marked with a blue star symbol. The GPC of pure ZnO as measured during the deposition of a thick ZnO film is = 0.2 nm/cycle at 150 °C (dashed red line).

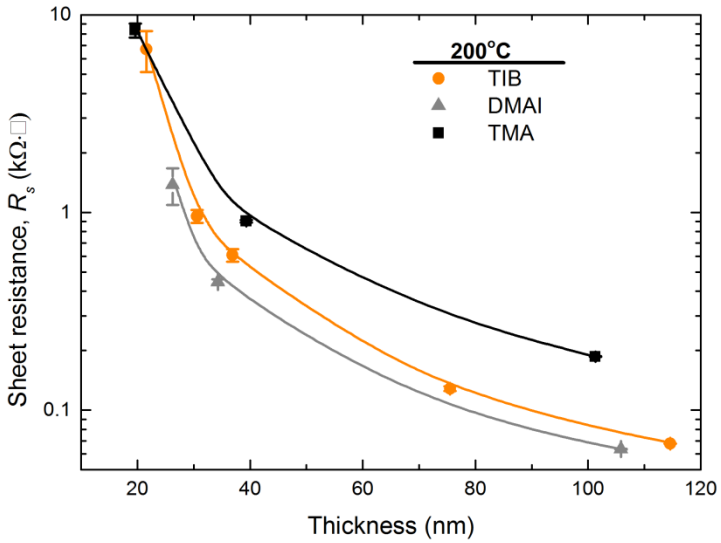

Fig. S2 Sheet resistance (R_s) of the ZnO:B (DF= 0.026, m = 24) and ZnO:Al (DMAI: DF= 0.03, m = 18; TMA: DF= 0.04, m = 35) samples deposited at 200°C on glass substrates as a function of the film thickness. Error bars are given, but in some cases they are lying within the data points.

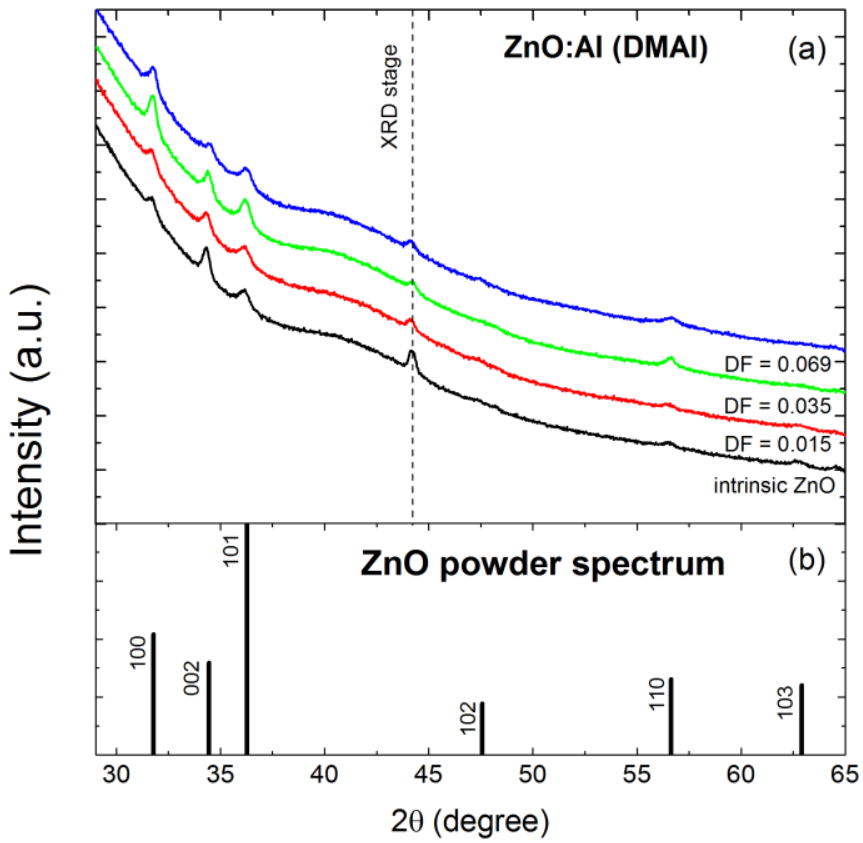

Fig. S3 (a) XRD patterns of 45 nm-thick ZnO:Al films (DMAI) deposited at 150 °C with different doping fractions (DF = 0.000 – 0.069) and (b) ZnO powder spectrum for reference. The peak labelled as 'XRD stage' corresponds to a peak related to the stage onto which the samples are mounted to perform the measurement, and its intensity depends on the size of the sample. This peak is not visible for larger samples.

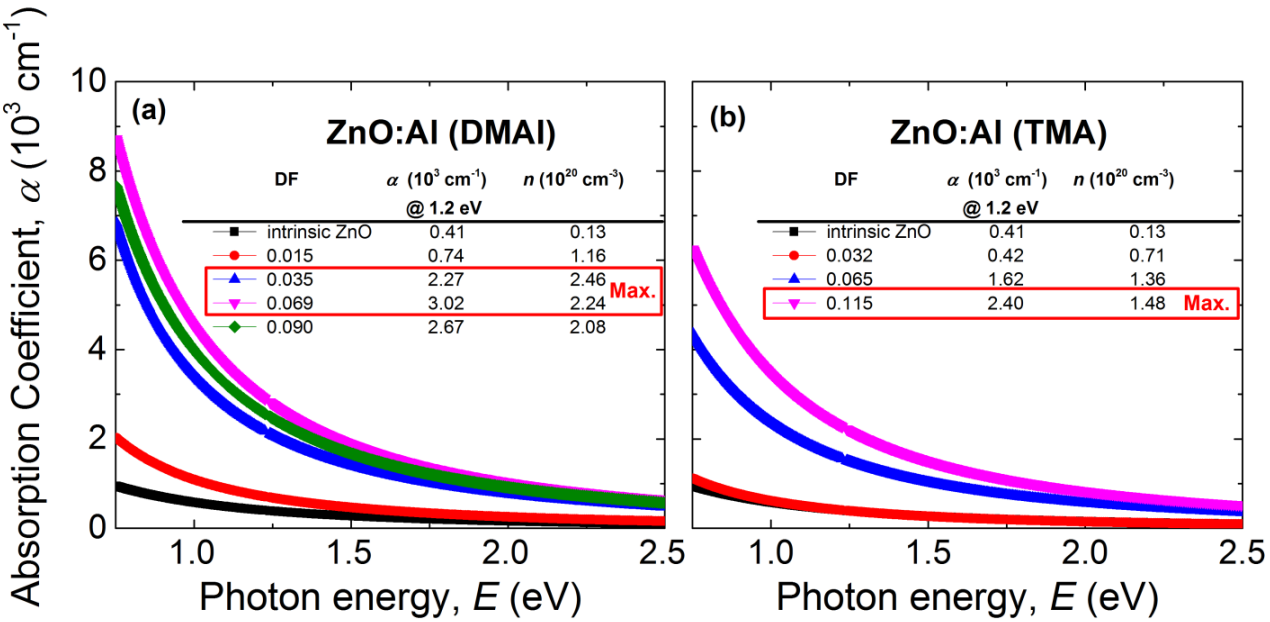

Fig. S4 Absorption coefficient (α) as a function of the photon energy (E) of the ALD ZnO:Al films doped using (a) DMAI and (b) TMA and deposited at 150 °C on glass substrates. The legend shows the correlation between α and the free carrier density (n).

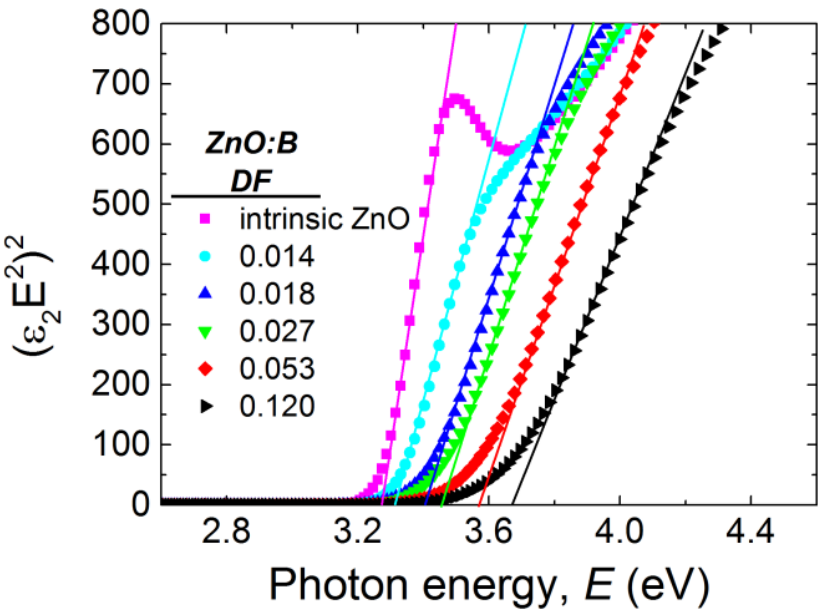

Fig. S5 Tauc plots for ZnO:B films with different doping fractions. The films were deposited on SiO_2 substrates at 150 °C.