Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary Information (S1)

Notice that the energy band gap is higher than the E_{go} ~ 3.30 eV of bulk ZnO in all the cases.[52] This amounts to widening of band gap with respect to bulk ZnO by 0.11, 0.21, 0.27, 0.29, and 0.32 eV. In contrast, Burstein-Moss shift of band gap deduced from[53]

$$\Delta E_{BM} = (h^2/8\ m_e^*)\ [3n/\pi]^{2/3} \quad (1)$$

taking $m_e^* = 0.3m_o$ with electron mass $m_o \sim 9.109\times10^{-31}$ kg at different carrier concentrations (n) turns out to be higher and in the range of 0.17–0.85 eV. Obviously, the observed variation in energy band gap is less and can be explained by invoking band gap renormalization/ narrowing as well.[54] The band gap narrowing (ΔE_{BGN}) is given by[54]

$$\Delta E_{BGN} = An^{1/3}\ [1- (n_c/n)^{1/3}] \quad (2)$$

where A is constant. The observed band gap (E_g) can be defined as

$$E_g = E_{go} + \Delta E_{BM} - \Delta E_{BGN} \quad (3)$$

Taking E_g, ΔE_{BM} as obtained from eq. (1), and E_{go} = 3.30 eV for bulk ZnO, ΔE_{BGN} has been deduced from eq. (3) for each case (Table 3). The linear fit of ΔE_{BGN} versus $n^{1/3}$ plot at higher carrier concentration gives slope 'A' and its intercept on abscissa (by extrapolation) corresponds to $n_c^{1/3}$ (Fig. S1(a)). Incidentally, ΔE_{BGN} versus n plots following eq. (2) with $n_c = 5.40 \times 10^{19}$ cm^{-3} and A = 1.055×10^{-7} eV–cm in semi-log and log-log scales shown in Fig. S1(b) are consistent with the experimental data.

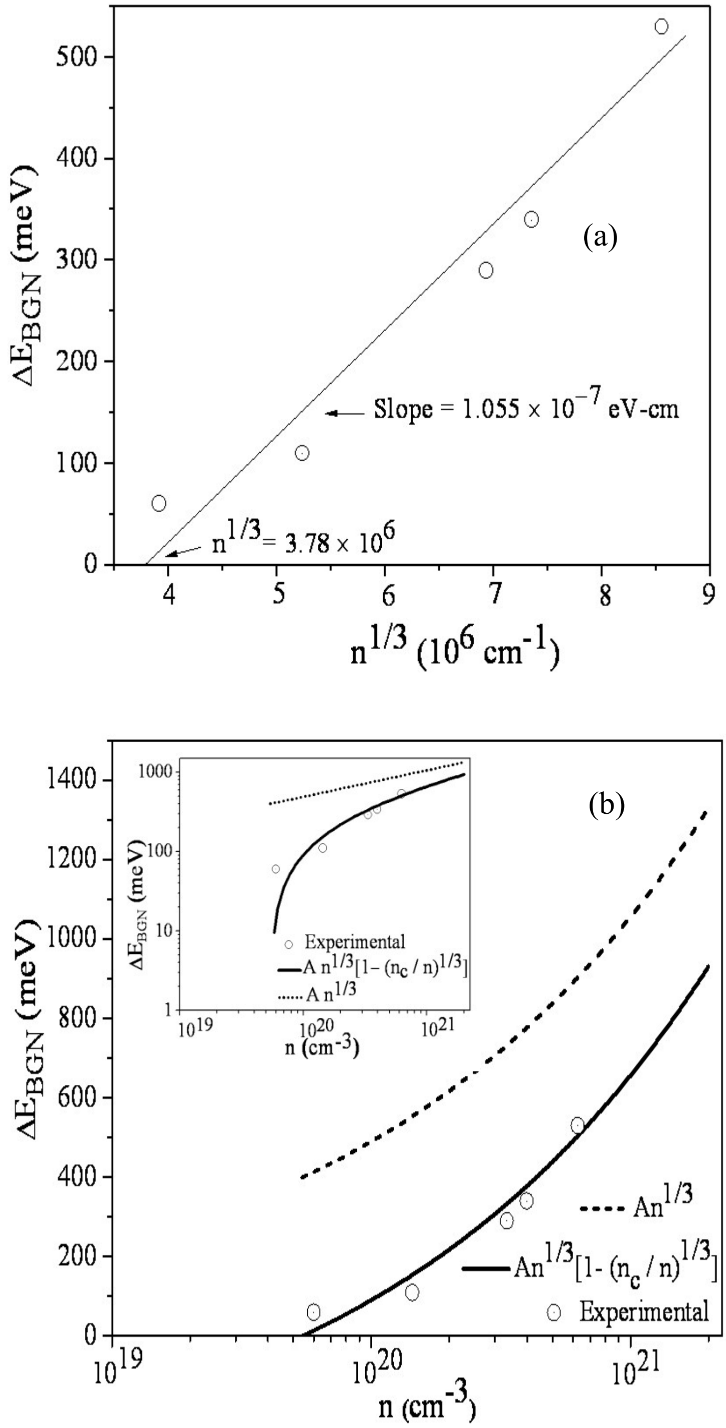

Figure S1. (a) ΔE_{BGN} versus $n^{1/3}$ plot of R.F. sputtered AZO films, (b) Nature of ΔE_{BGN} versus n plots following $\Delta E_{BGN} = An^{1/3}$ and $A\ n^{1/3}\ \{1-\ (n_c\ /\ n)^{1/3}\}$ with inset depicting the corresponding curves in log-log scale; the experimental data are shown by symbols.

The figure of merit,[55] expressed as $F_{TC} = -1/(\rho \ln T)$, where ρ is resistivity, T is average transmittance of film in visible region, improves in the AZO films with increase in R. F. power density and lies in the range 1.7×10^3 - 9.5×10^3 Ω^{-1} cm^{-1} (Table 3).