Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Sb-doped ZnO Microwires: Emitting Filament and Homojunction Light-emitting Diodes

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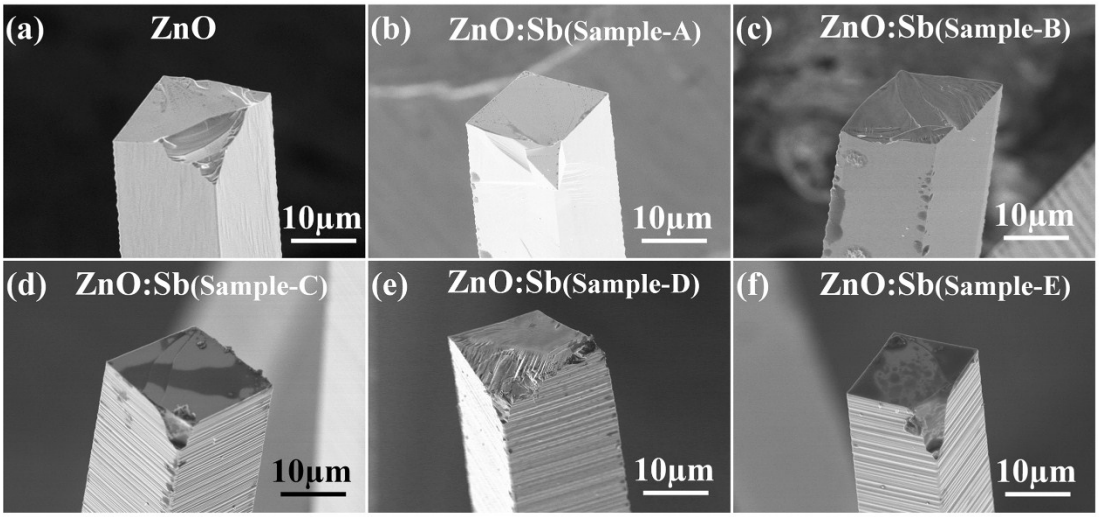

Figure S1. SEM images of the undoped ZnO and ZnO:Sb MWs with quadrilateral cross section corresponding to (a) undoped ZnO (ZnO : C = 1 : 1), (b) ZnO:Sb MWs of Sample-A (ZnO : Sb_2O_3 : C = 11 : 1 : 11), (c) ZnO:Sb MWs of Sample-B (ZnO : Sb_2O_3 : C = 10 : 1 : 11), (d) ZnO:Sb MWs of Sample -C (ZnO : Sb_2O_3 : C = 9 : 1 : 10), (e) ZnO:Sb MWs of Sample-D (ZnO : Sb_2O_3 : C = 8 : 1 : 9) and (f) ZnO:Sb MWs of Sample-F (ZnO : Sb_2O_3 : C = 7 : 1 : 8).

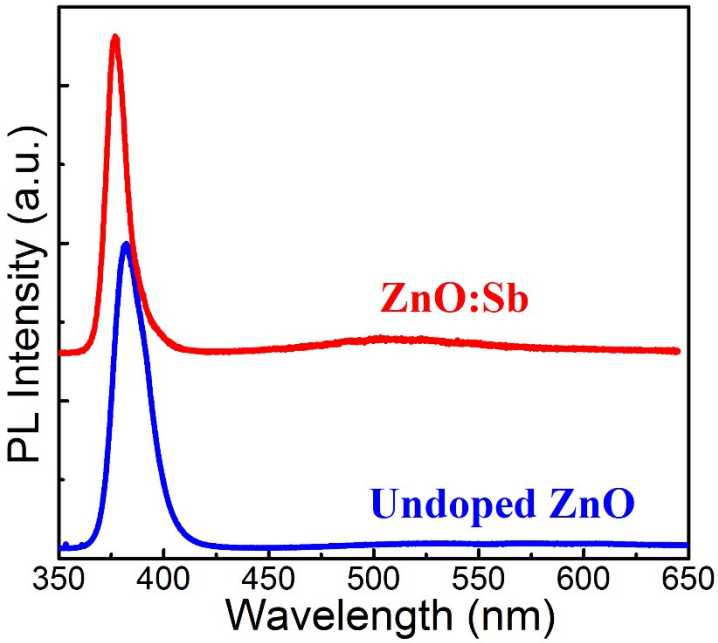

Figure S2. Room temperature normalized PL spectra of undoped ZnO MWs and ZnO:Sb MWs (weight ratio of ZnO : Sb_2O_3 : C = 10 : 1 : 11).

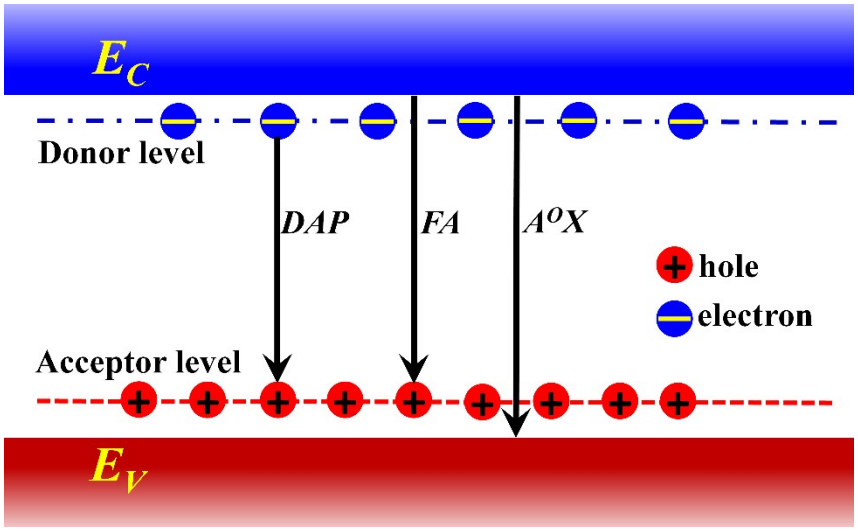

Figure S3. The band diagram of Sb-doped ZnO MWs.

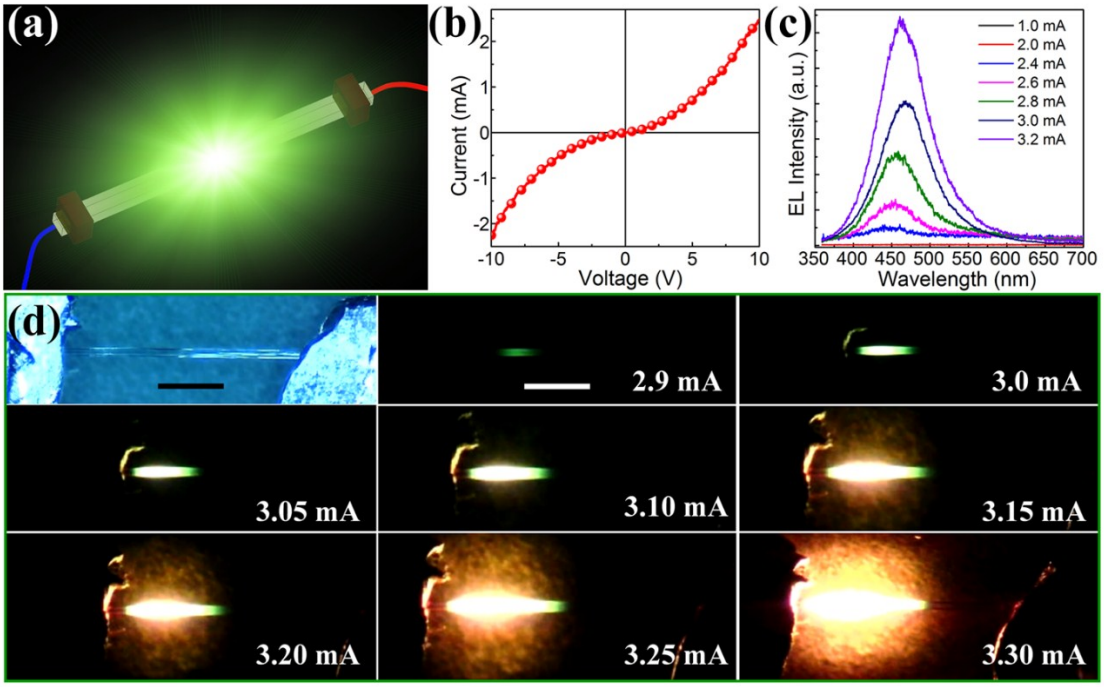

Figure S4. EL emission from electrically driven individual ZnO:Sb MWs: (a) Schematic illustration of light-emitting from electrically driven individual ZnO:Sb MWs, accordingly EL emission regions localized near the center of the MWs. (b) *I-V* characteristics of individual ZnO:Sb MW. (c) EL spectra of the electrically driven individual ZnO:Sb MW device with injection currents increases from 1.0 mA to 3.2 mA. (e) Image of the EL emission from the electrically driven individual ZnO:Sb MW with different injection current (scale bar, 250 μm).

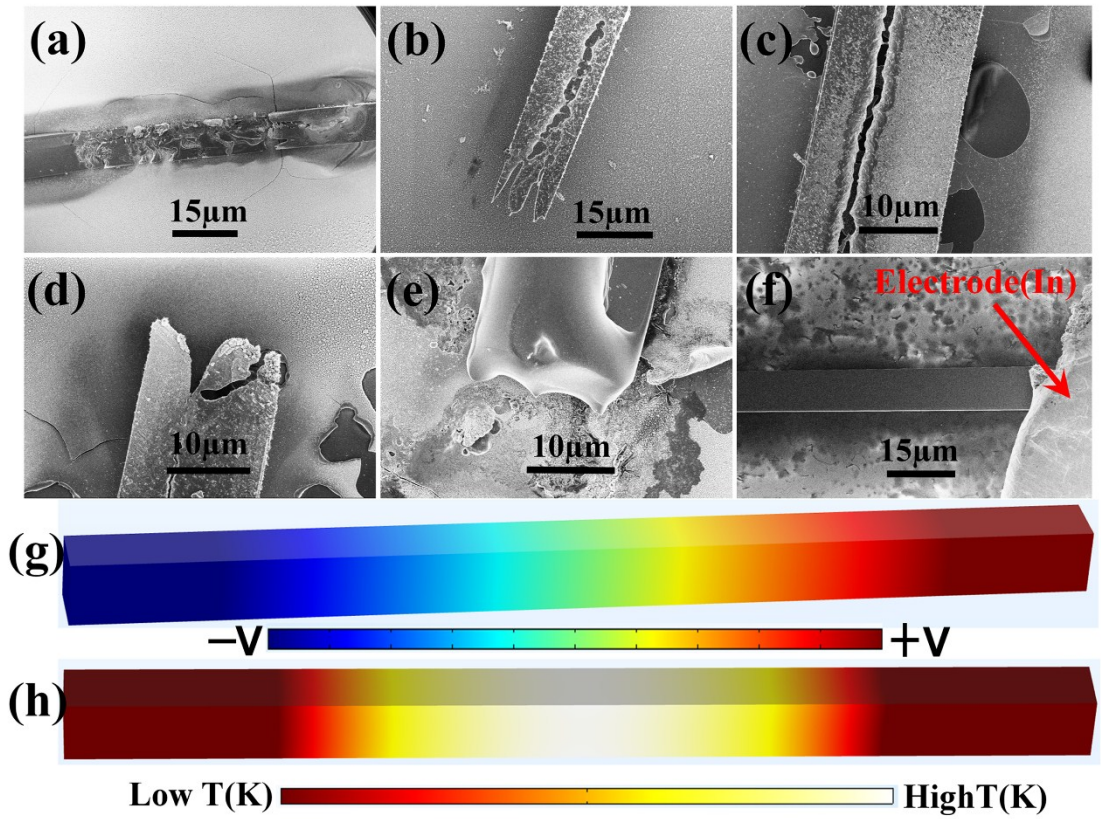

Figure S5. Electrical breakdown measurement of ZnO:Sb MWs: (a) SEM images of the broken ZnO:Sb MWs towards the center of wire. High magnification images of the broken MW, with plenty of microspheres and nanoparticles scattered around the broken regions, such as (b), (c), (d) and (e). (f) The contact area between electrode (In) and ZnO:Sb MWs, without any damages. Theoretical simulation and analysis of (g) electric potential field, and (h) thermal field distributions based on individual ZnO:Sb MWs.

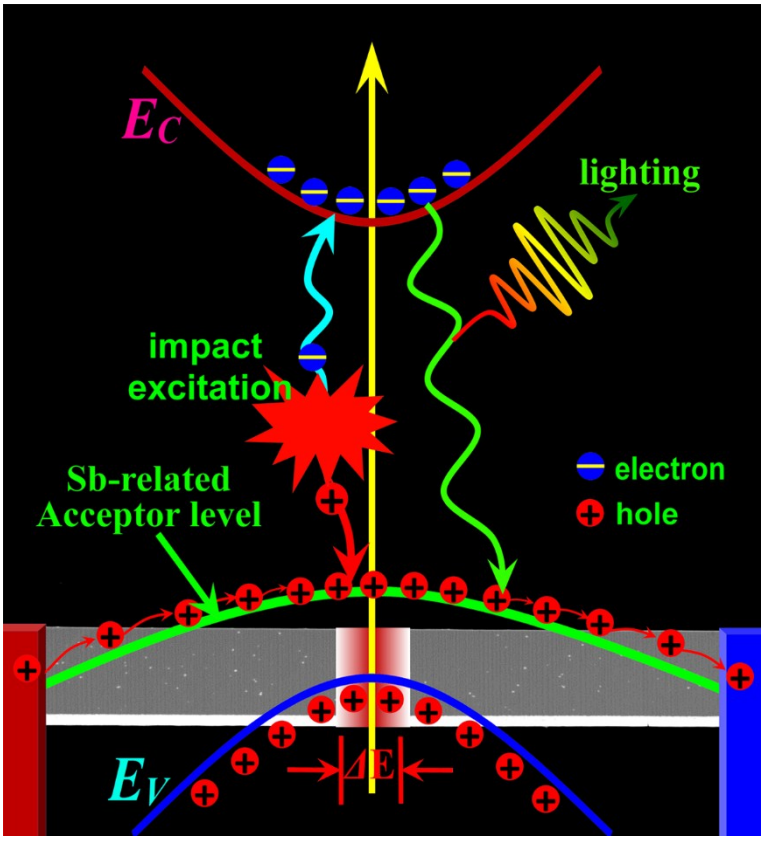

Figure S6. Schematic diagram of the possible working mechanism for EL emissions from electrically driven individual ZnO:Sb MWs: due to Joule heating effects, strong electric field could be formed towards the hottest spot; thus, holes transported in the channel could be accelerated, and becoming hot carriers; then impact excitation happened; electrons could be transited into conduction band by means of inelastic collision between hot holes and crystalline host lattice, thus radiative recombination could happen.

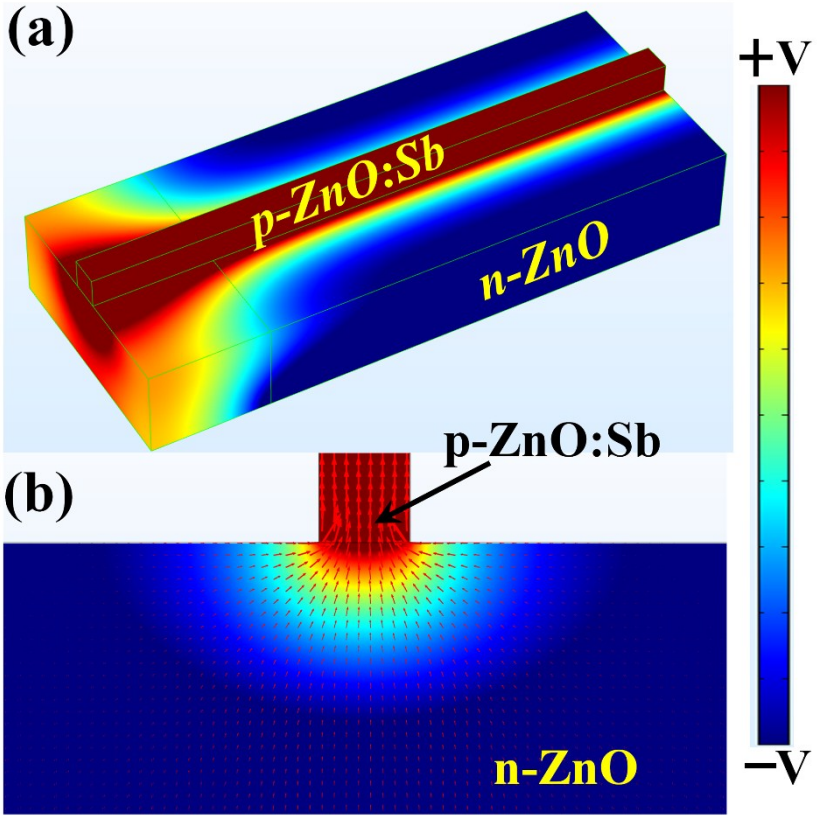

Figure S7. (a) Electric potential field distribution along the length of ZnO:Sb MWs of homojunction diodes. (b) Electric potential field distribution along the cross section of homojunction diodes.

Figure S8. Individual Sb-doped ZnO microwires were synthesized by a catalyst-free, vapor-solid process via chemical vapor deposition (CVD).