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Room temperature ferromagnetism of $Zn_{1-x}Co_xO$ thin films on Al_2O_3 by RF magnetron sputtering technique

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We report the synthesis of high-quality and room temperature ferromagnetic Co-doped $ZnO(Zn_{1-x}Co_xO)$ thin films using RF magnetron sputtering technique on (0001) sapphire substrates. At least up to $x=6.6wt\%$, the films have the single phase of the same wurtzite structure as pure ZnO, which was characterized by HR-XRD. SQUID magnetometer was used to characterize magnetic properties of $Zn_{1-x}Co_xO$ films at 300K. It shows typical hysteresis curves indicating room temperature ferromagnetism and that susceptibility gradually increase as Co content increase. The possible existance of Co metal cluster or Co surrounded by oxygen in $Zn_{1-x}Co_xO$ thin films could be excluded by the results of XPS analysis. Hall measurement was performed to define carrier type and concentration. All the samples are n-type characteristic and electron concentration varies from 6.39×10^{18} to 4.68×10^{19} according to Co content, which supports that room temperature ferromagnetism of $Zn_{1-x}Co_xO$ thin films is electron mediated. FESEM and EDS were also used to investigate surface morphology and composition of $Zn_{1-x}Co_xO$ thin films, respectively.