This thesis discusses the evolution of conduction mechanism in the silver (Ag) on zinc oxide (ZnO) thin film system with respect to the Ag morphology. As a plausible substitute for indium tin oxide (ITO), TCO/Metal/TCO (TMT) structure has received a lot of attentions as a prospective ITO substitute due to its low resistivity and desirable transmittance. However, the detailed conduction mechanism is not fully understood. In an attempt to investigate the conduction mechanism of the ZnO/Ag/ZnO thin film system with respect to the Ag microstructure, the top ZnO layer is removed, which offers a better view of Ag morphology by using scanning electron microscopy (SEM). With 2 nm thick Ag layer, it is seen that the Ag forms discrete islands with small islands size (r), but large separation (s); also the resistivity of the system is extremely high. This regime is designated as dielectric zone. In this regime, thermionic emission and activated tunneling conduction mechanisms are considered. Based on simulations, when “s” was beyond 6 nm, thermionic emission dominates; with “s” less than 6 nm, activated tunneling is the dominating mechanism. As the Ag thickness increases, the individual islands coalesce and Ag clusters are formed. At certain Ag thickness, there are one or several Ag clusters that percolate the ZnO film, and the resistivity of the system exhibits a tremendous drop simultaneously, because the conducting electrons do not need to overcome huge ZnO barrier to transport. This is recognized as percolation zone. As the Ag thickness grows, Ag film becomes more continuous and there are no individual islands left on the surface. The resistivity decreases and is comparable to the characteristics of metallic materials, so this regime is categorized as metallic zone. The simulation of the Ag thin film resistivity is performed in terms of Ag thickness, and the experimental data fits the simulation well, which supports the proposed models. Hall measurement and four point probe measurement are carried out to characterize the electrical properties of the thin film system.