

# THz Spectroscopic Studies of ITO Nanostructures

Date → Monday, **April 15<sup>th</sup>**, 2013

Time → **14:20-16:20**

Location → **R833**  
Dept. of Physics / Center for Condensed Matter  
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All Are Welcome!

## Abstract

A comparative study of indium-tin-oxide (ITO) nanowhiskers (NWs) and thin films were conducted. We employed both transmission-type and reflection-type terahertz time-domain spectroscopies (THz-TDTS and THz-TDRS) to explore the far-infrared optical properties of these samples. Their electrical properties, such as plasma frequencies, carrier scattering times, were analyzed and found to be fitted well by the Drude-Smith model in the 0.1~1.4 THz frequency range. Further, structural and crystalline properties of samples were examined by scanning electron microscopy and X-ray diffraction, respectively. Non-Drude behavior of complex conductivities in ITO NWs is attributed to carrier scattering from grain boundaries and impurity ions. In ITO thin films, however, observed non-Drude behavior is ascribed to scattering by impurity ions only. Considering NWs and thin films with the same height, the DC and real part of the THz conductivities of ITO films are always better than those of NWs. On the other hand, DC mobility ( $38\sim 125\text{ cm}^2\text{V}^{-1}\text{s}^{-1}$ ) of the former is larger than that of the latter, due to the longer carrier scattering time of the NWs and fewer scattering centers. The transmittance of ITO NWs ( $\cong 60\sim 70\%$ ) is much higher ( $\cong 20$  times) than that of ITO thin films in the THz frequency range.

