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Title:THz conductivities of indium-Tin-oxide nanowhiskers as a graded-refractive-index structure
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Abstract:Indium-Tin-oxide (ITO) nanowhiskers with attractive electrical and anti-reflection properties were prepared by the glancing-Angle electron-beam evaporation technique. Structural and crystalline properties of such nanostructures were examined by scanning transmission electron microscopy and X-ray diffraction. Their frequency-dependent complex conductivities, refractive indices and absorption coefficients have been characterized with terahertz time-domain spectroscopy (THz-TDS), in which the nanowhiskers were considered as a graded-refractive-index (GRIN) structure instead of the usual thin film model. The electrical properties of ITO GRIN structures are analyzed and fitted well with Drude-Smith model in the 0.2~2.0 THz band. Our results indicate that the ITO nanowhiskers and its bottom layer atop the substrate exhibit longer carrier scattering times than ITO thin films. This signifies that ITO nanowhiskers have an excellent crystallinity with large grain size, consistent with X-ray data. Besides, we show a strong backscattering effect and fully carrier localization in the ITO nanowhiskers. © 2012 Optical Society of America.
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