Characterization of Metamaterial Devices Using Terahertz Time-Domain Spectroscopy

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Crucible Coating Analysis by THz Spectroscopy

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Crucibles are found commonly throughout many industrial and scientific applications which require a containment vessel capable of withstanding temperatures high enough to melt or otherwise adversely affect it. Thin coatings protect the interior walls of the crucible, and play a critical role in its overall life span. Industry needs to be able to quality test their products in a nondestructive manner, while at the same time, gather coating application information in regards to uniformity, thickness, and impurities in the substrate beneath the coatings. Using pulsed Terahertz frequency radiation, it is possible to see through many materials including crucible coatings. Using terahertz “Time of Flight Imaging” along with other TDS (time domain spectroscopy) applications we will show how crucible coatings can be characterized and mapped with spatial resolutions of less than a millimeter and thickness resolutions less than 50 microns.

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Bending the realm of physics, materials are being synthesized that exhibit unnatural optical phenomenon such as negative refractive indices. Metamaterials are manufactured with sub-wavelength features such that they have special electric permittivity and magnetic permeability properties. This can produce an effective negative refractive index device with high potential for eventual use in invisibility cloaking devices, enhanced light-weight lenses, and more sensitive sensors. Using Terahertz Time-Domain Spectroscopy, we characterize a metamaterial device at multiple incident angles in both transmission and reflection. This analysis can be utilized in designing other metamaterials devices that can produce negative refractive indices at the terahertz regime as well as other electromagnetic frequencies.