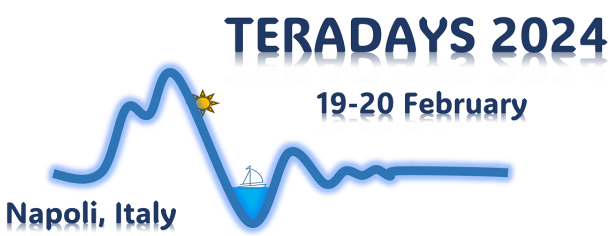

Contribution ID : **25** Type : **not specified**

Optical Permittivity and Permeability in the THz Band from Independent Measurements of Normal Transmission and Reflection

lunedì 19 febbraio 2024 12:20 (20)

An accurate retrieval procedure has been developed in order to extract both the dielectric and magnetic response of thin and thick samples in the THz band. Differently from a previous approach [1], the exact expressions of the complex reflection $\tilde{R}$ and transmission $\tilde{T}$ of the THz beam normally impinging on the sample surface are used. The core of the methodology consists in the independent employment of the experimental $\tilde{R}$ and $\tilde{T}$ values, processed by a total variation technique [2] to retrieve the complex impedance $\tilde{z}$ and refractive index $\tilde{n}$, namely $\tilde{z}_R$, $\tilde{z}_T$, $\tilde{n}_R$, $\tilde{n}_T$. From here the dielectric function $\tilde{\varepsilon}$ and permeability $\tilde{\mu}$ are obtained through $\tilde{\varepsilon}_i$=$\tilde{n}_i$ $\tilde{z}_i$ $\tilde{\mu}_i$=$\tilde{n}_i$/ $\tilde{z}_i$ to achieve $\tilde{\varepsilon}_R$, $\tilde{\varepsilon}_T$, $\tilde{\mu}_R$, $\tilde{\mu}_T$. The technique is applied to a thin film of BiFeO3 showing a small but finite magnetization and a phononic resonance at about 2 THz [3]. The BiFeO3 films have been grown on quartz, following a procedure similar to that previously optimized for the deposition on Si (100) substrate [4]. In particular, the films have been deposited in the temperature range 600–800 ℃ for 60 min using the Bi(phenyl)3 and Fe(tmhd)3 (phenyl = –C6H5, H-tmhd = 2,2,6,6-tetramethyl-3,5-heptandione), as precursors. The X-ray diffraction patterns, recorded in grazing incidence mode (0.8°), have confirmed the formation of pure, polycrystalline BiFeO3 films, while the field emission scanning electron microscopy image indicates the presence of grains of about 500-600 nm.

References 1. H. Němec, F. Kadlec, P. Kužel, L. Duvillaret, and J. L. Coutaz, “Independent determination of the complex refractive index and wave impedance by time-domain terahertz spectroscopy,” Opt. Commun. 260(1), 175–183 (2006). 2. L. Duvillaret, F. Garet, and J. L. Coutaz, “A reliable method for extraction of material parameters in terahertz time-domain spectroscopy,” IEEE J. Sel. Top. Quantum Electron. 2(3), 739–745 (1996). 3. G. A. Komandin, V. I. Torgashev, A. A. Volkov, O. E. Porodinkov, A. A. Pronin, L. D. Iskhakova, and A. A. Bush, “Effect of BiFeO 3 ceramics morphology on electrodynamic properties in the terahertz frequency range,” Phys. Solid State 54(6), 1191–1198 (2012). 4. Q. Micard, G. G. Condorelli and G. Malandrino, “Piezoelectric BiFeO3 Thin Films: Optimization of MOCVD Process on Si”, Nanomaterials 10, 630/1-630/10 (2020).

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Session Classification : II session