Highlights

ACTIVITY D Light-matter interaction and non-equilibrium dynamics in advanced materials and devices- 2020

All-carbon THz components based on laser-treated diamond

S. Amoruso[1,2], A. Andreone[1,2], A. Bellucci[3], C. Koral[4], M. Girolami[3], M. Mastellone[3], S. Mou[1], S. Orlando[3], G.P. Papari[1], D. Paparo[5], R. Polini[6], A. Rubano[1,5], A. Santagata[3], V. Serpente[3], V. Valentini[3], and D.M. Trucchi[3]

[1]Dipartimento di Fisica, Università di Napoli Federico II, Complesso Universitario di Monte S. Angelo, Via Cintia, I-80126 Napoli, Italy
[2]CNR-SPIN, SuPerconducting and other INnovative materials and devices Institute, UOS Napoli, Complesso Universitario di Monte S. Angelo, Via Cintia, I-80126 Napoli, Italy
[3]CNR-ISM, Institute for Structure of Matter ISM-CNR, DiaTHEMA Lab, Via Salaria km 29.300, Monterotondo Scalo (RM), Italy
[4]Istituto Nazionale di Fisica Nucleare, Sezione di Napoli, via Cintia, I-80126, Napoli, Italy
[5]CNR-ISASI, Institute of Applied Science & Intelligent Systems (ISASI) 'E. Caianiello', Via Campi Flegrei 34, 80078 Pozzuoli (NA), Italy
[6]Università di Roma "Tor Vergata", Dipartimento di Scienze e Tecnologie Chimiche, Via della Ricerca Scientifica 1, 00133 Roma, Italy

CARBON 163, 197-201 (2020)

Diamond and graphite are two allotropes of carbon with very different physical properties that arise from their distinct crystal structures. Laser induced graphitization of diamond can therefore provide an interesting route for the fabrication of novel functional materials thanks to the extremely different electrical and optical properties of diamond and graphitic-like materials allowing one to engineer a sample of diamond crystal at the surface or in the volume. In this context, a proof of principle experiment was carried out on the transmittance in the THz spectral range of diamond plates irradiated by ultrashort laser pulses. The laser irradiation generates laser induced periodic surface structures (LIPSS) with a period of about 170 nm allowing to fabricate a layer presenting graphitized ripples with a preferential orientation. The transmittance of the samples to THz with polarization parallel and perpendicular to the ripples formed on the laser structured sample was analyzed both in a narrow (0.2-1.5 THz) and a broad (0.25-6 THz) spectral range. The experimental findings evidence a clear anisotropic absorption to polarized THz radiation in the range 0.25-3 THz that can be exploited for the fabrication of robust, lightweight and broadband THz optical components.

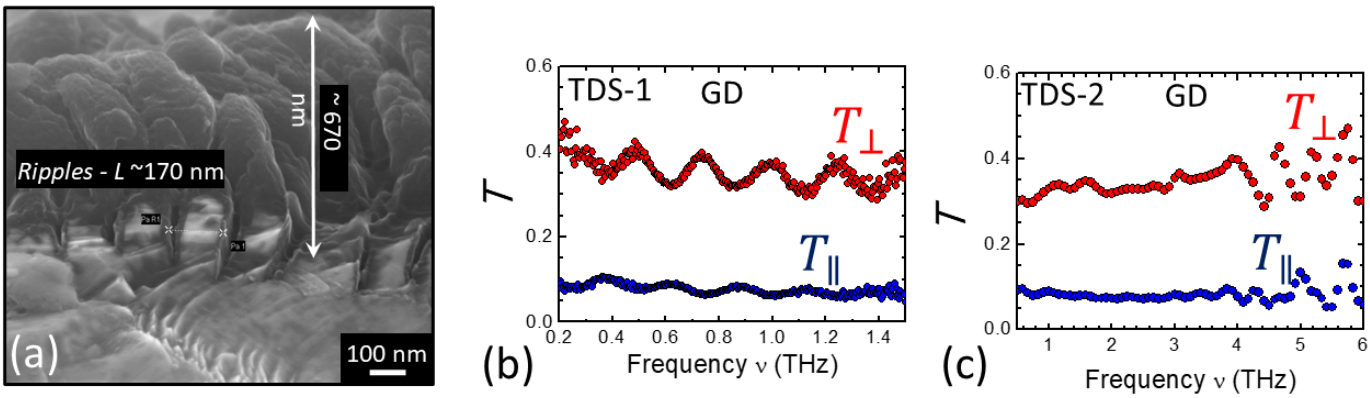

Fig. 1: (a) SEM images showing a cross-section of graphitized diamond and LIPSS; Panels (b) and (c): transmittance of graphitized diamond samples to a THz wave for THz electric field polarization orthogonal ($T_\perp$, red symbols) parallel ($T_{||}$, blue symbols) to the LIPSS orientation.