

Supplementary Information

External cavity terahertz quantum cascade laser with a metamaterial/graphene optoelectronic mirror.

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S1- Unit cell parameters

The single unit cell has the same dimensions as the first device reported in Ref. [26] in the main text but scaled by a factor of 0.48. The width of the connecting biasing lines was kept fixed to 1 μm . The width of the unit cell lines was 1.44 μm . A basic sketch of the unit cell and the values of the main parameters are reported in Figure S1 and in Table 1S, respectively.

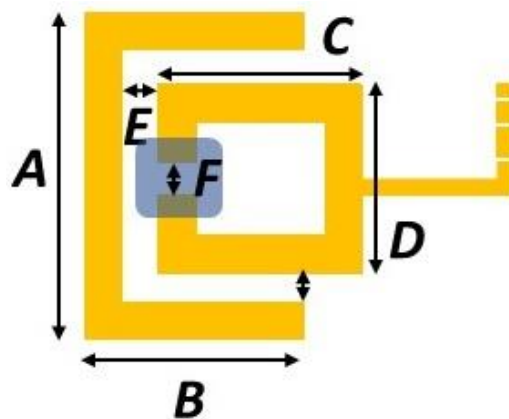


Figure S1: the main parameters of the standard unit cell in the metamaterial/graphene EIT device.

The grey area shunting the gap in the inner resonator represents the graphene patch, having an area of $3.1 \times 3.1 \mu\text{m}^2$.

Table S1: nominal values of the main parameters in the unit cell of the EIT array

Parameter	Nominal value (μm)
A	9.60
B	5.76
C	8.16
D	4.80
E	0.96
F	0.77

S2- Graphene conductivity

Two Keithley 2400 voltage source-measure units were used for the electrical characterization of a graphene patch with area of $1.2 \times 1 \text{ mm}^2$ which was fabricated in parallel to the devices. One Keithley was used to apply the back voltage through the p-doped Si substrate and the

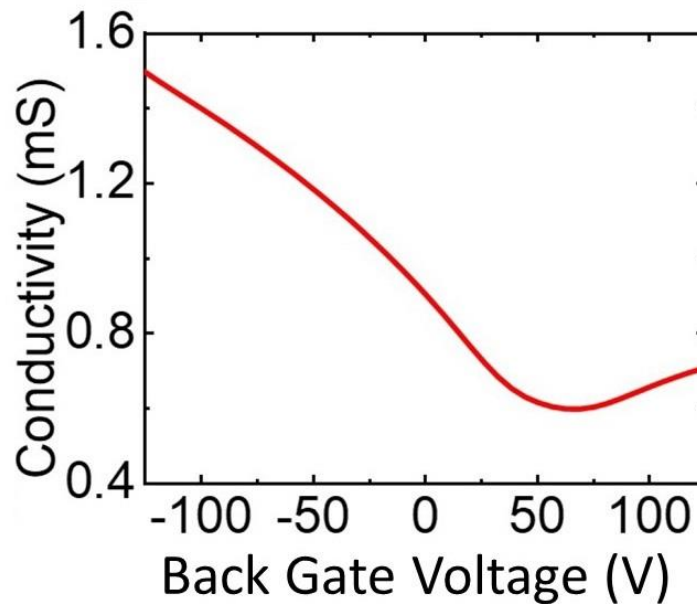


Figure S2: Graphene conductivity for different back-gate voltages.

other was used to source $1 \mu\text{A}$ through the graphene source-drain contacts while measuring the required voltage. The DC sheet conductivity at different back gate voltages was retrieved from the measured resistance and from the dimensions of the graphene area. It is presented in Figure S2. The Dirac point was experimentally found at approximately 60 V corresponding to a conductivity of 0.6 mS. The same conductivity range was attributed to the graphene patches shorting the metamaterial units since this graphene area was on the same SiO_2/Si chip and was processed together with the other EIT devices.