Article

Supplementary Information: Modeling 2D Arrangements of Graphene Nanoribbons

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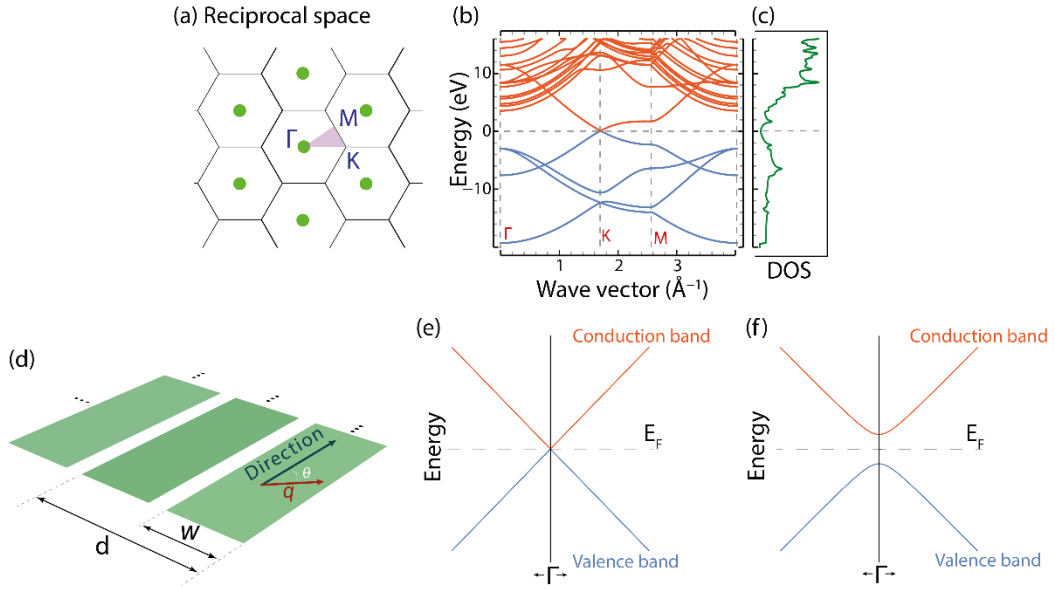


Figure S1. (a) Reciprocal space of graphene with the first irreducible Brillouin zone along the ΓKMΓ path. (b) Band structure and (c) density of stated (DOS) of graphene. (d) Schematic representation of a freestanding graphene nanoribbon array, w represent the width of the ribbon, q represents the plasmon momentum, and θ represents the plasmon excitation angle. Hypothetical band structure of (e) wide GNRs and (f) narrow GNRs around the Γ point.

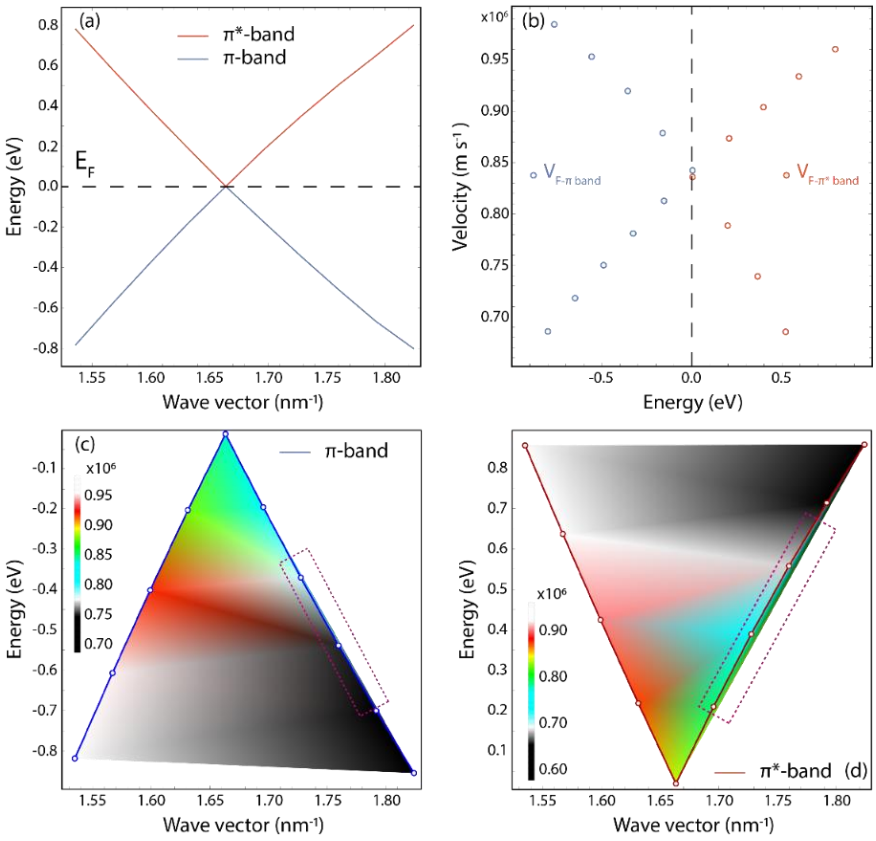


Figure S2. (a) Band structure of graphene around the K point, considering the π and π^* bands. (b) Group velocity of graphene around the K point vs. the single-particle energy. The group velocity of graphene (color bar, 10^6 m s^{-1}) as a function of the single-particle energy dispersions vs wave vector for the (c) π and (d) π^* bands, around the K point.

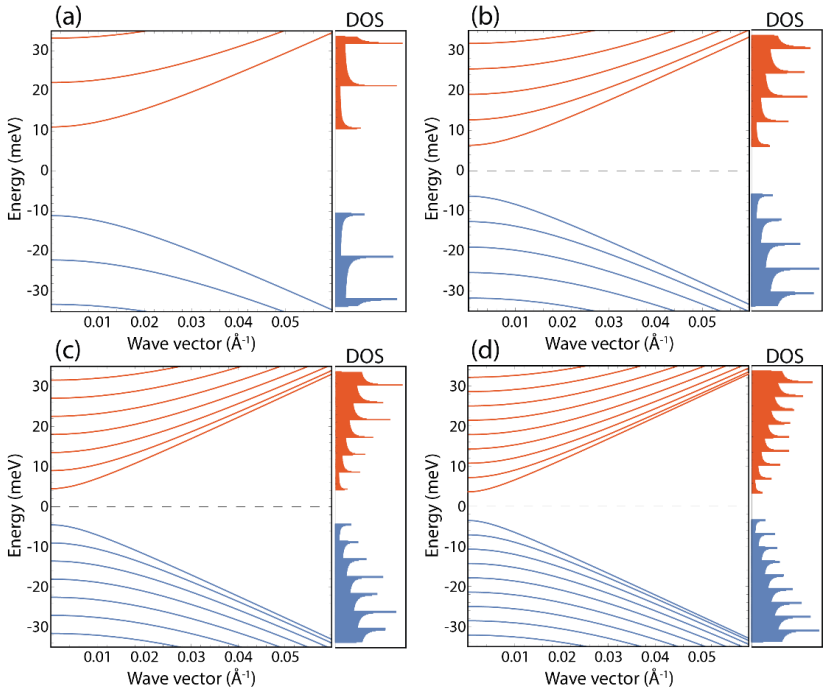


Figure S3. Band structure and density of states (DOS) as a function of wave vector of experimental GNRs with different widths: (a) 155 nm, (b) 270 nm, (c) 380 nm, and (d) 480 nm.

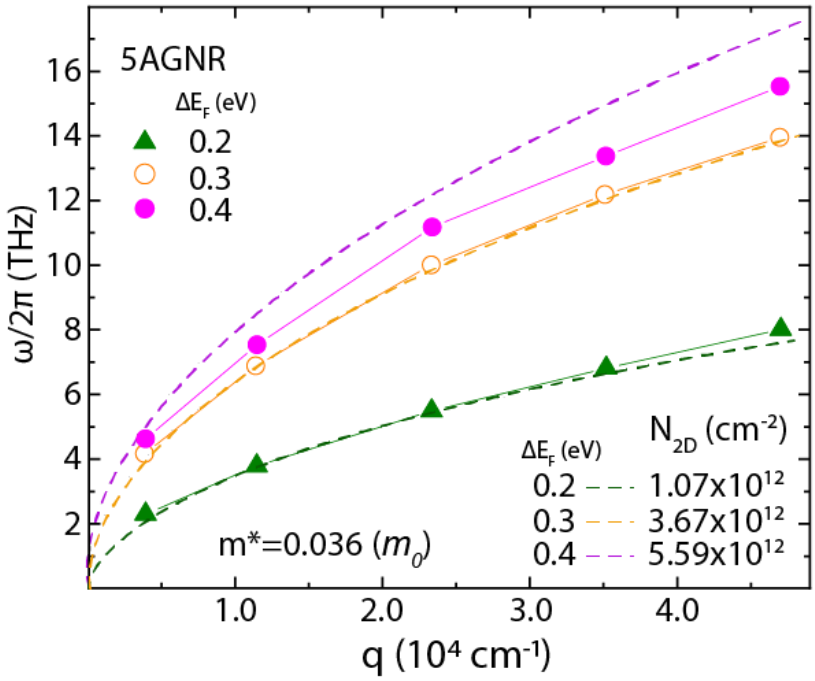


Figure S4. Plasmon frequency dispersion ($\omega/2\pi$) vs. wave vector (q) for five armchair graphene nanoribbon (5AGNR), considering the numerical TDDFT+RPA approach [Ref. 19 in the main text] and the predictions of the semi-analytical model through Equation (6). The input parameters of Equation (6) are given in the figure.

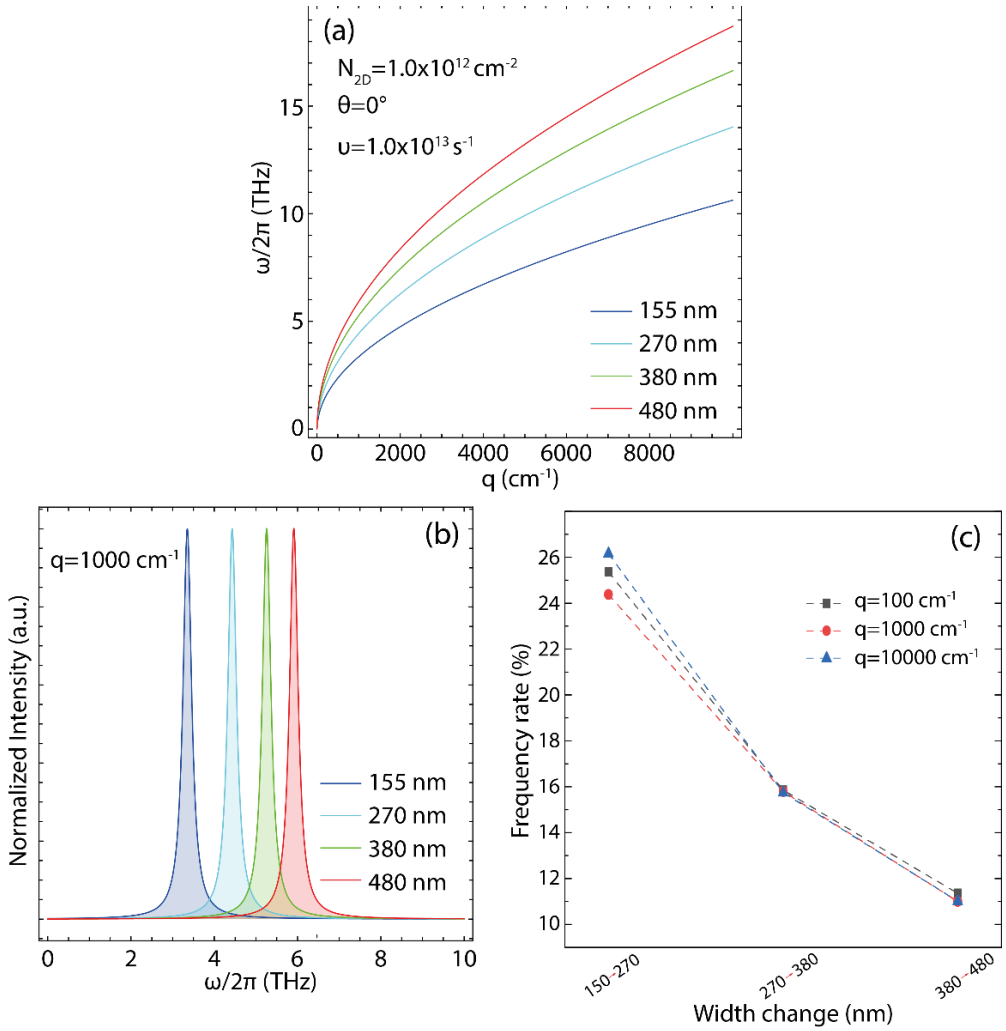


Figure S5. (a) Frequency-momentum dispersion as a function of the plasmon momentum using the charge carrier velocity of freestanding graphene ($v_F = 0.829 \times 10^6$ m s^{-1}) for the experimental 2D GNR arrays (w = 155, 270, 380, 480 nm). (b) Maximum of the plasmon peak (≤ 10 THz) at plasmon momentum q = 1000 cm^{-1}, considering different ribbon widths. (c) Percentage variation in plasmon frequency rate as a function of the ribbon width increment, for three selected plasmon momenta (q = 100, 1000, 10000 cm^{-1}).

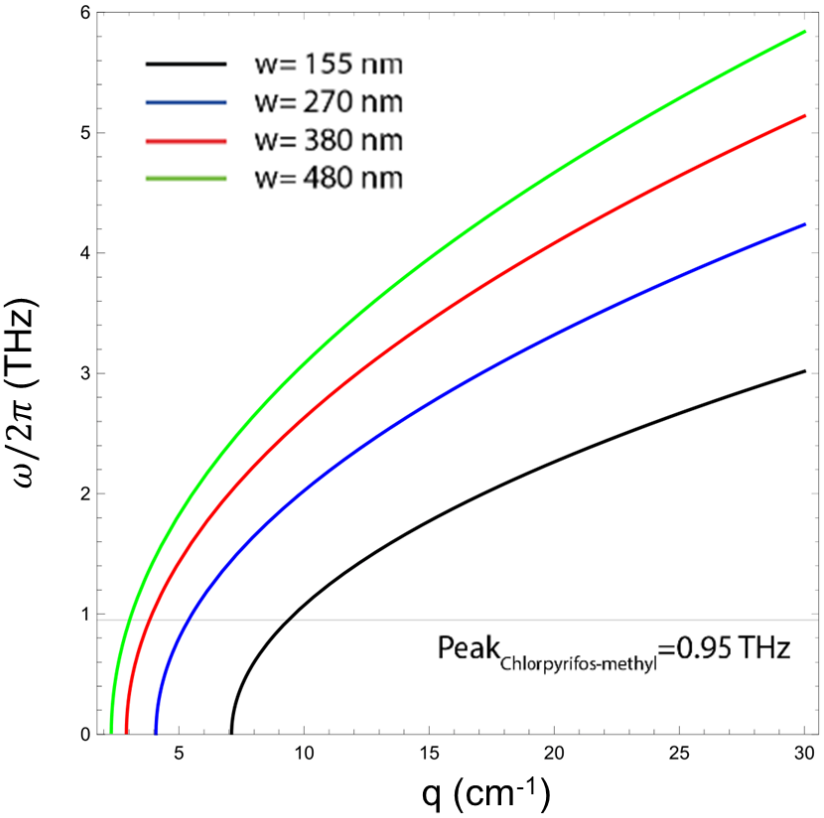


Figure S6. Frequency-momentum dispersion as a function of the plasmon momentum using the charge carrier velocity of freestanding graphene ($v_F = 0.829 \times 10^6$ m s^{-1}) for the experimental 2D GNR arrays ($w = 155,\ 270,\ 380,\ 480$ nm).

19 Gomez, C.V.; Pisarra, M.; Gravina, M.; Pitarke, J.M.; Sindona, A. Plasmon Modes of Graphene Nanoribbons with Periodic Planar Arrangements. *Phys. Rev. Lett.* **2016**, *117*, 116801. https://doi.org/10.1103/physrevlett.117.116801.