

Supplementary Materials for
The effect of doping and strain on superconductivity of
T-graphene

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I. The phonon spectra of T-graphene in doped and/or strained cases

We calculated the phonon spectra of the T-graphene for the cases of (1) hole doping, (2) biaxial tensile straining (BTS), (3) 0.5 hole/unit cell doping and BTS, and (4) 0.8 hole/unit cell doping and BTS, with the results shown in Figs. S1, S2, S3 and S4, respectively. Figs. S1 and S2 shows the change of phonon spectra with the increase of doping and BTS, respectively. Fig. S1 shows that imaginary frequency appears when the doping level is larger than 0.2 hole/unit cell. From Fig. S2, it is clearly seen that imaginary frequency appears when the BTS is larger than 10%. Figs. S3 and S4 show the change of phonon spectra with the increase of BTS under 0.5 and 0.8 hole/unit cell doping, respectively. There are imaginary frequencies for the two cases, which can be stabilized by BTS. However, when the BTS are larger than 12% and 10%, imaginary frequencies reappear, indicating that the lattice is no longer stable for the two cases.

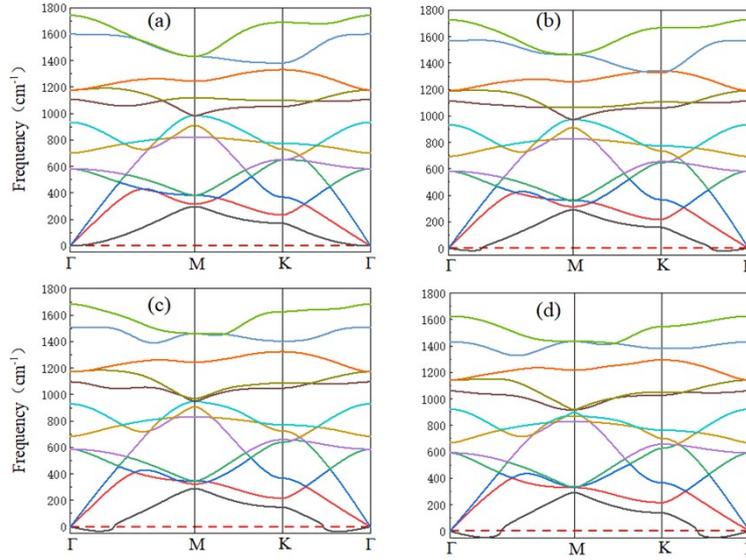


Fig. S1: Phonon spectra of T-graphene under hole doping of (a) 0.2, (b) 0.4, (c) 0.6, (d) 0.8.

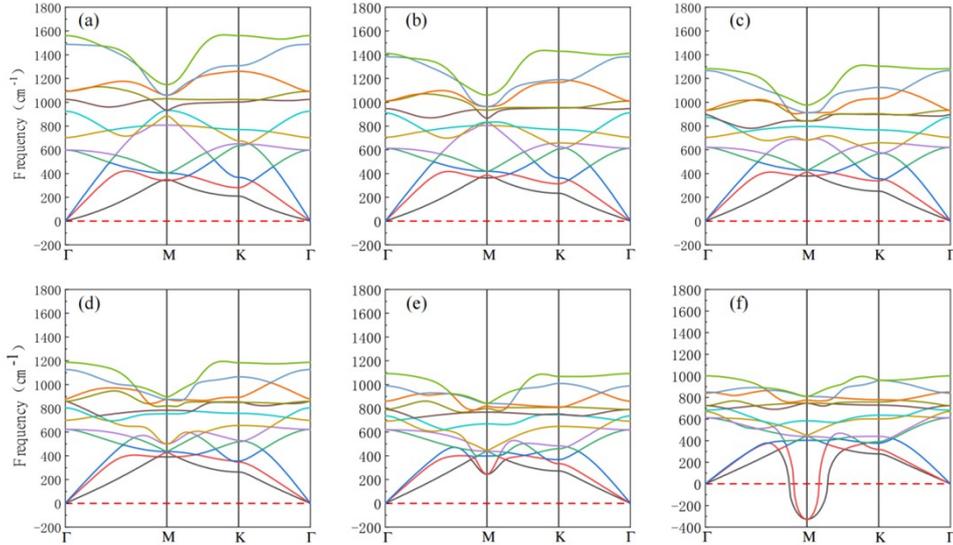


Fig. S2: Phonon spectra of T-graphene under BTS of (a) 2%, (b) 4%, (c) 6%, (d) 8%, (e) 10%, (f) 12%.

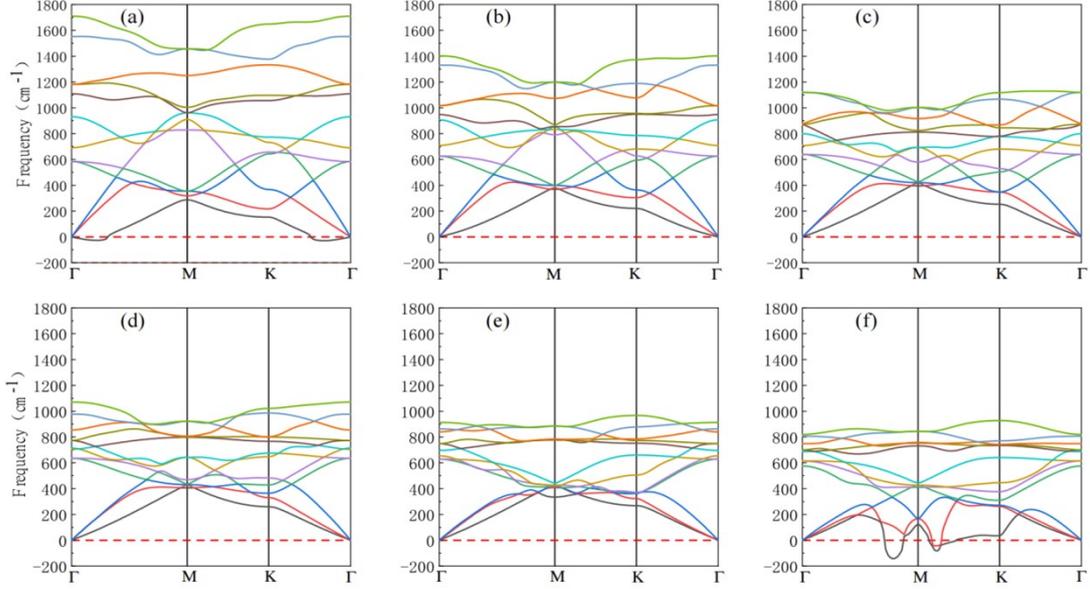


Fig. S3: Phonon spectra of T-graphene under 0.5 hole/unit cell doping and BTS of (a) 0%, (b) 4%, (c) 8%, (d) 10%, (e) 12%, (f) 14%.

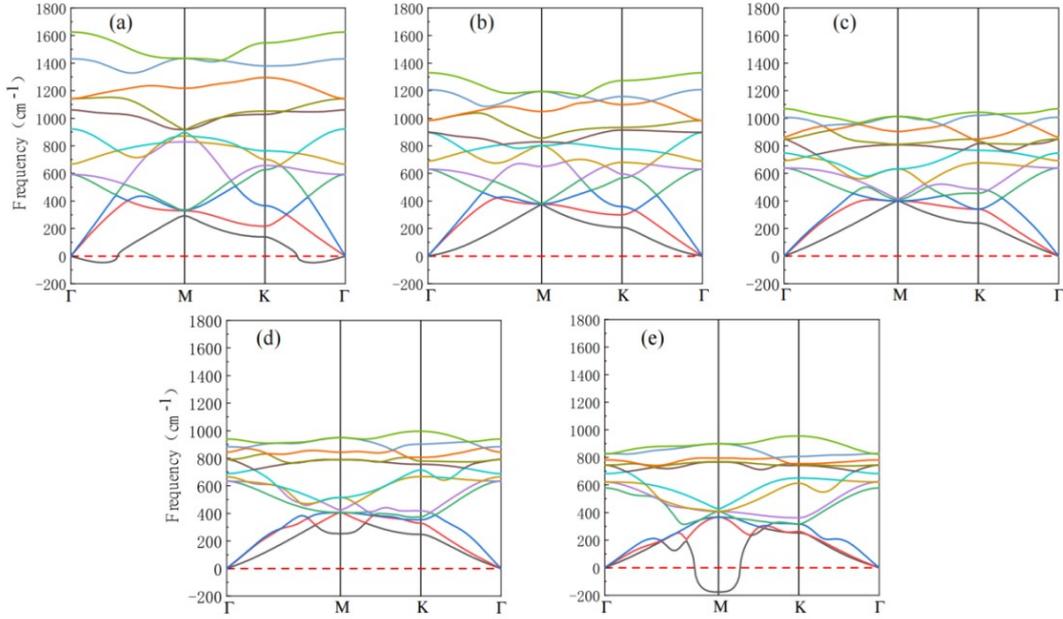


Fig. S4: Phonon spectra of T-graphene under 0.8 hole/unit cell doping and BTS of (a) 0%, (b) 4%, (c) 8%, (d) 10%, (e) 12%.

II. The possible superconductivity of T-graphene in doped and/or strained cases

Table S1 lists the superconducting parameters for pristine T-graphene, as well as the doped and/or strained cases listed in Figs. S2, S3 and S4. It is seen that the superconducting critical temperature (T_c) of T-graphene increases with the increase of doping concentration and BTS. The T_c increases significantly in the cases of (1) 0.5 hole/unit cell doping and BTS of 12%, and (2) 0.8 hole/unit cell doping and BTS of 10%, thus, we mainly analyze the two cases in the main text.

Table S1: List of the calculated superconducting parameters, including the logarithmic averaged phonon frequency ω_{log} (K), electron-phonon coupling λ and superconducting critical temperature T_c (K) for pristine T-graphene, as well as the doped and/or strained cases listed in Figs. S1, S2 and S3. p is the hole doping level in $|e|/\text{unit cell}$, and ε is tensile strain, i.e., the relative increase of the lattice constant.

p	ε	ω_{log}	λ	T_c
0	0%	1658.74	0.161	0
0	2%	1471.57	0.175	0
0	4%	1348.20	0.229	0.02
0	6%	1152.49	0.291	0.4
0	8%	916.57	0.412	4.5
0	10%	558.31	0.739	22.1
0	12%	unstable		
0.5	0%	unstable		
0.5	4%	1288.66	0.223	0.01
0.5	8%	975.89	0.347	1.6
0.5	10%	837.10	0.445	6.1
0.5	12%	590.74	0.807	28.2
0.5	14%	unstable		
0.8	0%	unstable		
0.8	4%	1077.65	0.312	0.8
0.8	8%	794.79	0.531	12.1
0.8	10%	558.89	0.939	35.2
0.8	12%	unstable		