Supporting Information for

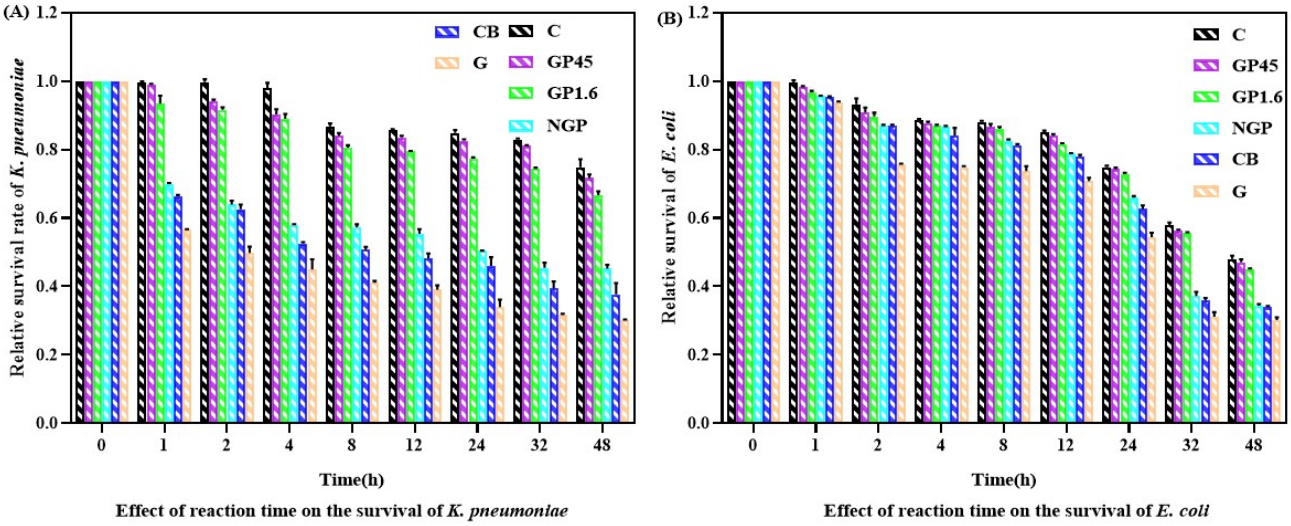
Carbonaceous particulate matters promote horizontal transfer of antibiotic resistance genes

Table S1. Primer sequences used in this study(Rubini et al. 2019, Zhang et al. 2018).

Category	Gene	Primer	Sequence of Primer (5'-3')
cfuOxidative stress-related genes	*soxS*	*soxS-F*	AATCGGACGCTCGGTGGT
		soxS-R	AAATCAGGCTATTCAAAGTGGT
	soxR	*soxR-F*	ATTGGTGAAGCGTTTGGC
		soxR-R	CAATACATCCGTCCAGTTCGT
SOS response-related genes	*recA*	*recA-F*	CGCTTTCGGCGTCAGT
		recA-R	ACAACCTGCTGTGCTCCC
	lexA	*lexA-F*	AATGCTGATTTCCTGCTGC
		lexA-R	CGACTTTATTGCCCTGTTTT
Outer membrane protein genes	*ompA*	*ompA-F*	TGAGCCTGGGTGTTTCCTA
		ompA-R	CAGAGCAGCCTGACCTTCC
	ompC	*ompC-F*	AAGTAGTAGGTAGCACCAACATCA
		ompC-R	GGGCGAACAAAGCACAGAA
Mating pair formation (Mpf) system genes	*trbBp*	*trbBp-F*	CGCGGTCGCCATCTTCACG
		trbBp-R	TGCCCGAGCCAGTACCGCCAATG
DNA transfer and replication (Dtr) system	*trfAp*	*trfAp-F*	GAAGCCCATCGCCGTCGCCTGTAG
		trfAp-R	GCCGACGATGACGAACTGGTGTGG
Pilin synthesis-related genes	*fimA*	*fimA-F*	ACTACACCCTGCGTTTCGAC
		fimA-R	GCGTTAGAGTTTGCCTGACC
	fimH	*fimH-F*	GTGCCAATTCCTCTTACCGTT
		fimH-R	TGGAATAATCGTACCGTTGCG
	pilA	*pilA-F*	CGAATCATACCAACGTACTGGC
		PilA-R	GGCACCAACTGCATAATAACGC
16S rRNA	*16S rRNA*	*16s-F*	CCTACGGGAGGCAGCAG
		16s-R	ATTACCGCGGCTGCTGG

Figure S1. Effect of CPM on bacterial survival

The density of the bacterial solution was 10^8 CFU/mL and the final concentration of CPM was 320mg/L at 25℃. Some of the bacterial solutions were removed for colony counting at 1, 2, 4, 8, 12, 24, 32 and 48h respectively. Different selection plates were used to distinguish the two types of cells and the number of donor and recipient bacteria were counted separately.



A. Effects of CPM on the survival of receptor strain *K. pneumoniae* in different time periods.
B. Effects of CPM on the survival of donor strain *E. coli* in different time periods.

Figure S2

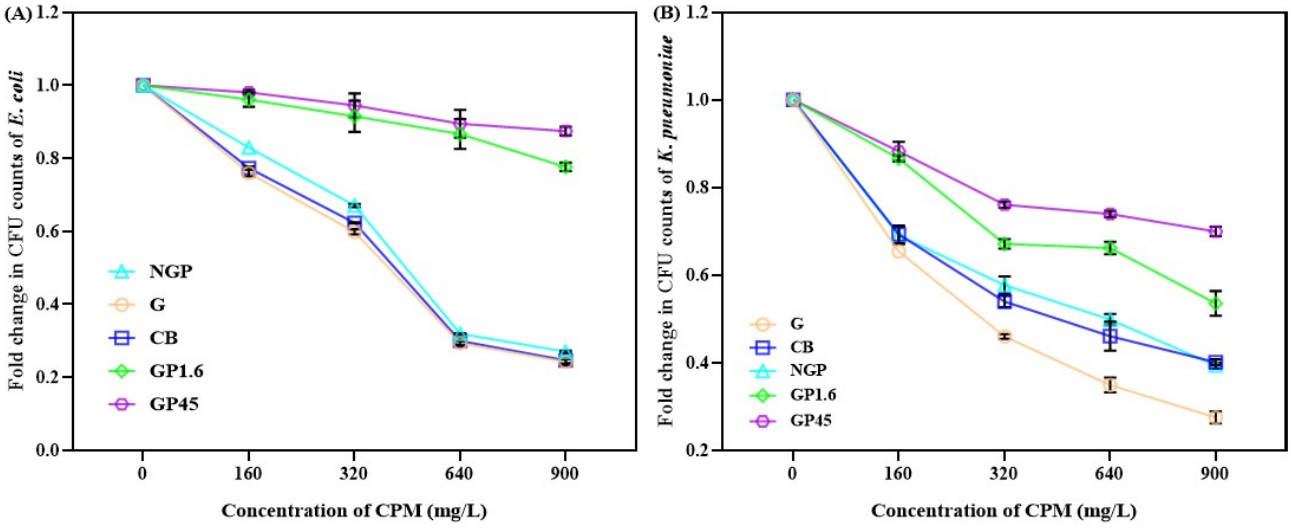


Figure S2. Effects of CPM with different concentrations on the survival of donor(*E. coli*)nd recipient(*K. pneumoniae*) bacteria. Conditions (PBS,8h,10^8 CFU/mL,20rpm)

Text S1

CB (Carbon black), G (Graphene), NGP (Nano graphite powder), GP1.6 (1.6 micron graphite powder), GP45 (45 micron graphite powder).

CB(particle size:10-20nm),G(thickness:1-2nm),GP1.6(particle size: 8000 mesh ,1.6 microns),GP45(particle size: 325 mesh ,45microns)were purchased from Shanghai McLean Biochemical Technology Co., Ltd., and NGP(particle size:200-600nm)was purchased from Aladdin Chemical Reagent Co., Ltd. CPM is suspended in a certain amount of sterile ultrapure water, and uniformly dispersed by ultrasonic wave (KQ-500E50W) as mother liquor, which is ultrasonicated for 2h before each use.

CAS:G(1034343-98-0),CB(1333-86-4),GP(7782-42-5),NPG(7782-42-5).

AMP(69-52-3),KAN(25389-94-0) ,TET(A500731)and MEM(96036-03-2).

Text S2

Transmission electron microscope (TEM)

Collect the cells in the conjugation transfer experiment system (25℃, 4h, 10^8 CFU/mL), put them in a 1.5mL centrifuge tube, add 2.5% glutaraldehyde solution and store them at 4℃ for 12h. Pour off the fixative, and rinse the sample with 0.1M phosphate buffer with pH7.0 for three times, each time lasting 15min；Fix the sample with 1% osmic acid solution for 1-2h; Take out the osmic acid waste liquid carefully, and rinse the sample with 0.1M phosphate buffer with pH7.0 for three times, each time lasting 15min；Dehydrate the sample with gradient concentration (including 30%, 50%, 70%, 80%, 90% and 95% ethanol solution), each concentration is treated for 15min, and then treated with 100% ethanol for 20min；Finally, it was treated with pure

acetone for 20min. Treat the sample with the mixture of embedding agent and acetone (V/V=1/1) for 1h; Treat the sample with the mixture of embedding agent and acetone (V/V=3/1) for 3h; Treating the sample with pure embedding agent overnight; Embedding the infiltrated sample, and heating at 70°C overnight to obtain the embedded sample. Samples were sliced in an ultrathin microtome (LEICA EM UC7) to obtain 70-90nm slices. The slices were stained with lead citrate solution and 50% ethanol saturated solution of uranyl acetate for 5-10 minutes respectively, and then observed under transmission electron microscope after drying.

References

Rubini D, Banu SF, Subramani P, Hari BNV, Gowrishankar S, Pandian SK, Wilson A, Nithyanand P (2019): Extracted chitosan disrupts quorum sensing mediated virulence factors in Urinary tract infection causing pathogens. Pathog Dis 77

Zhang Y, Gu AZ, Cen T, Li X, Li D, Chen J (2018): Petrol and diesel exhaust particles accelerate the horizontal transfer of plasmid-mediated antimicrobial resistance genes. Environ Int 114, 280-287