Supplementary information

Designing Nanoscaled Hybrids from Atomic Layered Boron Nitride

Embedded with Silver Nanoparticles

Guanhui Gao,[†, ‡] Akshay Mathkar,[‡] Eric Perim Martins,[§] Douglas S. Galvão,[§] Duyang Gao,[†] Pedro Alves da Silva Autreto,[§] Chengjun Sun,[*] Lintao Cai,[†,*] Pulickel M. Ajayan[‡,*]

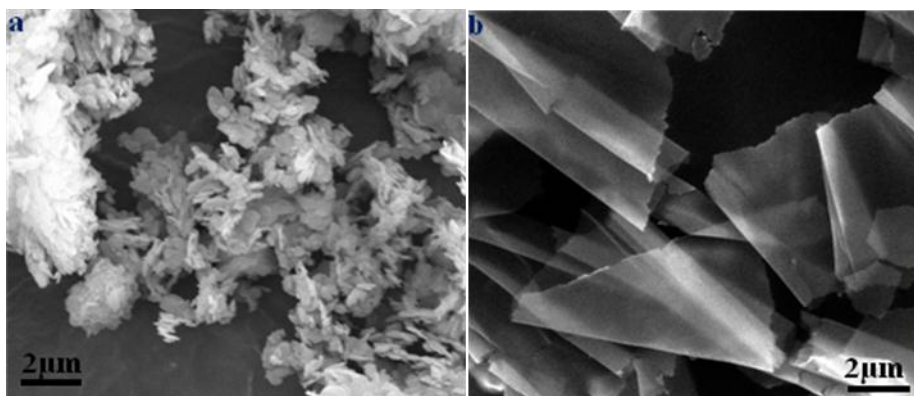## S1 Characterizations of exfoliated h–BN nanosheets and SNP/h–BN hybrid composites

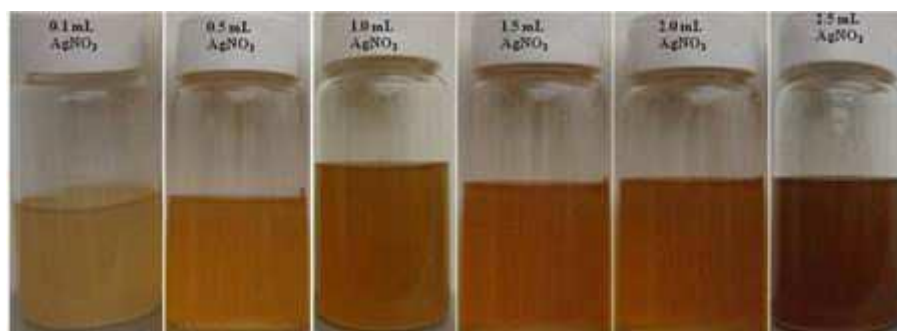Figure S1 (a) SEM images of pristine BN powder; (b) SEM images of exfoliated h-BN

Figure S2 SNP/h-BN composites with different content ratio of Ag/h-BN (from left to right: 0.001/5, 0.005/5, 0.01/5, 0.015/5, 0.02/5, 0.025/5, mmol/mg).
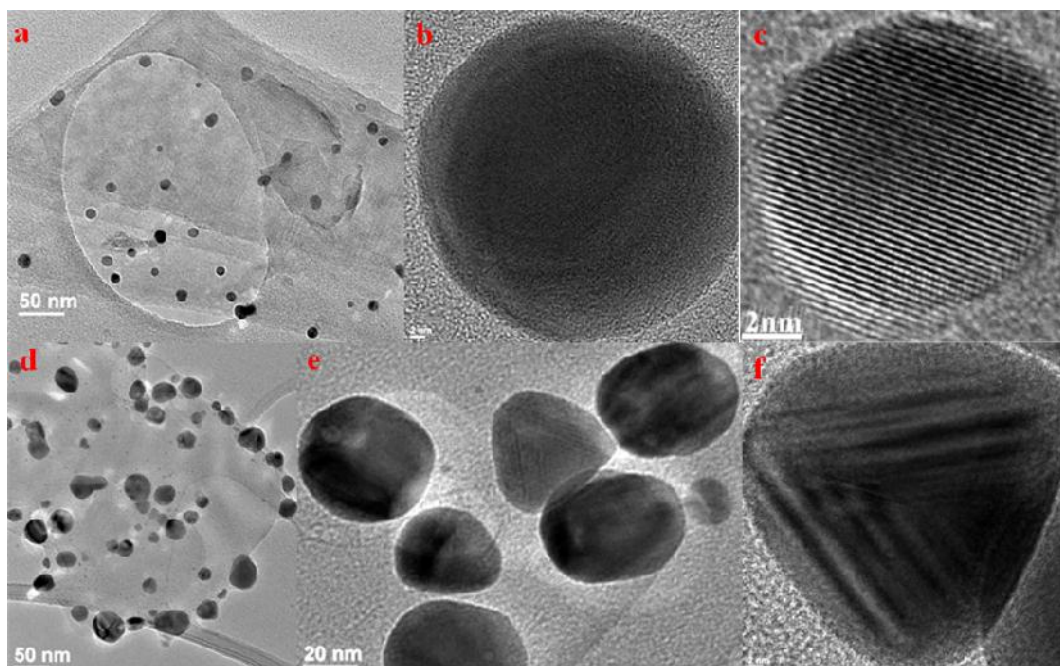
Figure S3 TEM images of various concentrations of SNP/h–BN nanohybrids. (a, d) low–resolution TEM of SNP/h–BN hybrid composites; (b-c) high–resolution TEM single crystalline and polycrystalline structural silver nanoparticles; (e-f) multi–crystalline structural silver nanoparticles.
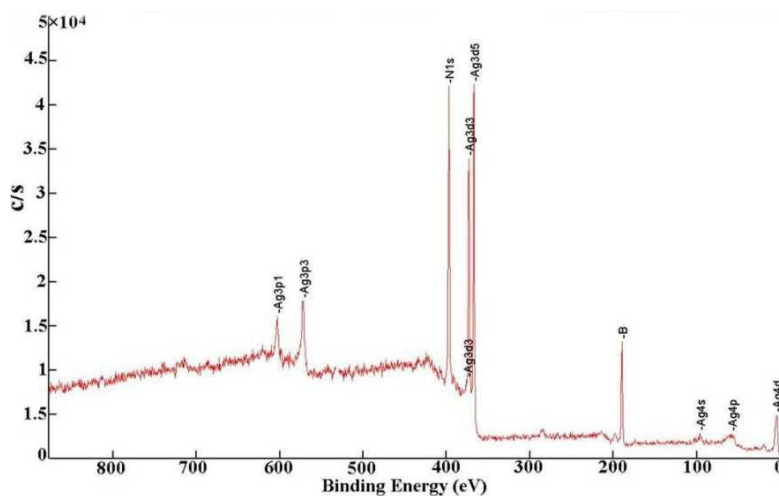

Figure S4 XPS full scan of SNP/h–BN composites

S2 Band gap calculation

Boron nitride (h–BN) is a promising material for such laser devices because it has a direct band gap in the ultraviolet region. Energy band calculations are carried out using the relation

$$\alpha = \Sigma \alpha = \frac{A_i(h\nu - E_{gi})}{h\nu}$$

where the value of Egi corresponds to the optical absorption coefficient. For allowed

direct, allowed indirect, forbidden direct and forbidden indirect transitions, the value of mi corresponds to 1/2, 2, 3/2 and 3, respectively. Above equation (can be rewritten in the following form

$$\alpha = \frac{(h\nu - E_g)^{1/2}}{h\nu}$$

$h\nu = E$, $\nu = c/\lambda$ (λ is the UV–vis absorption wavelength). The plot of ($\alpha hc/\lambda$) versus hc/λ should be a straight line at the absorption range. The intersection point with the x–axis is Eg (Eg is the bandgap), where the optical gap wavelength can be calculated based on $\lambda g = hc/Eg$ (see Fig. 5a and Fig. S5).
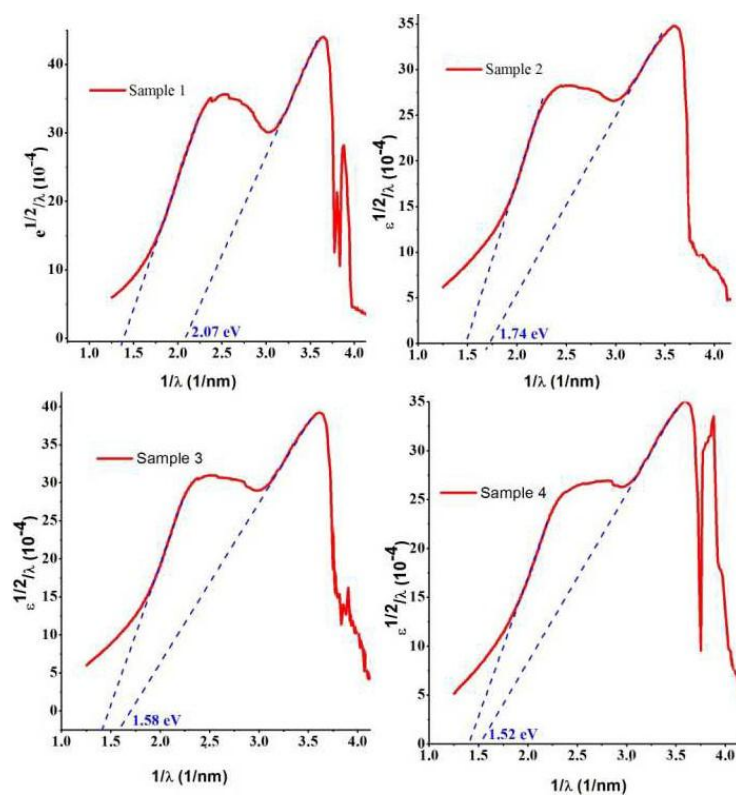

Figure S5 (a) Band gap analysis of SNP/h–BN composites (1.7/5, wt.); (b) Band gap analysis of SNP/h–BN composites (2.55/5, wt.); (c) Band gap analysis of SNP/h–BN composites (3.4/5, wt.); (d) Band gap analysis of SNP/h–BN composites; (4.25/5, wt.).

S3 Preparation of Antibacterial Test

The antibacterial effect of the solution was measured by plate counting and bacteriostatic zone methods. No bacterial growth occurred around the center of fungicide. The larger the diameter of the inhibition zone, the stronger was the

composite's bactericidal property. The bacterium was extracted from sea water from the Qingdao area and cultivated using ZZ16E culture medium. The PCR primers was designed to identify the strain of 16S rRNA genes, and then the homology of the resultant DNA sequence was compared with GenBank sequence data. The bacterium was *Chlorophenols Arthrobacter* (*C.A*), a gram-negative bacterium (Fig. S6).
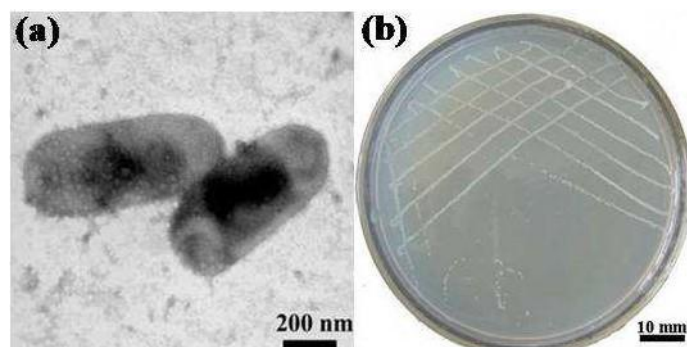

Figure S6 (a) TEM morphology of *Chlorophenol Arthrobacter (C.A)*; (b) photograph of the *C.A* cultivated using plate streaking method
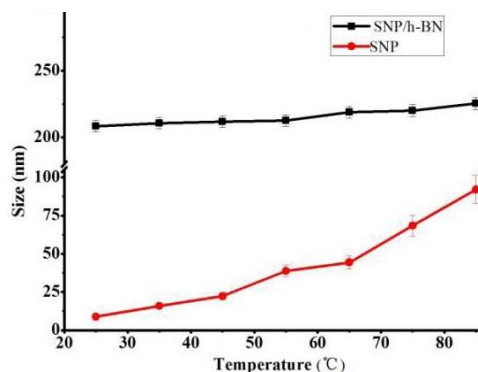
S4 Thermal stability test of SNP and SNP/h–BN

Figure S7 Thermal stability measurement of SNP and SNP/h–BN

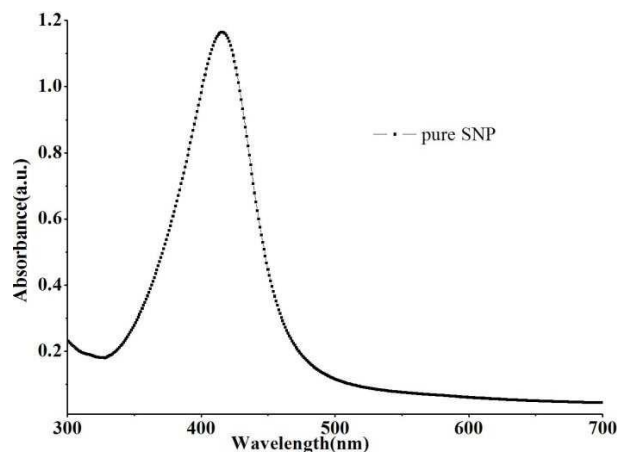## S5 Ultraviolet–visible absorption spectrum of pure silver nanoparticles

Figure S8 Ultraviolet-visible absorption spectrum of pure silver nanoparticles.

4