## Supporting Information For Review Only

## Antibacterial and Algicidal Effects of Porous Carbon Cuboid Nanoparticles

Dimitra Karageorgou<sup>a</sup>, Eleni Thomou<sup>b</sup>, Nikolina T. Vourvou<sup>a</sup>, Kyriaki-Marina Lyra<sup>b</sup>, Nikolaos Chalmpes<sup>b</sup>, Apostolos Enotiadis<sup>c,s</sup>, Konstantinos Spyrou<sup>b,s,\*</sup> Petros Katapodis<sup>a,\*</sup> Dimitrios Gournis<sup>b</sup> and Haralambos Stamatis<sup>a</sup>

a Laboratory of Biotechnology, Department of Biological Applications and Technologies,

University of Ioannina, 45110, Greece

b Department of Materials Science and Engineering, University of Ioannina, 45110, Greece

c National Center for Scientific Research "Demokritos", 15341, Ag. Paraskevi Attikis, Athens,

Greece

\* Corresponding Authors

EDX spectra (Figure S1) confirm the presence of each metal that was used for the final hybrid carbon nanostructure materials.



Figure S1. EDX spectra (Figure S1.) of the final hybrid materials PCC-Ag (top) and PCC-Cu (bottom).

Cu 2p X-ray photoelectron spectroscopy (Figure S2.) was employed in order to investigate the type of oxidation of Cu nanoparticles. The binding energy of Cu 2p was corrected considering the charge shift observed for the carbon carbon bonds of PCC centered at 285 eV.



Figure S2. Cu 2p X-Ray Photoelectron Spectroscopy of PCC-Cu

XRD was employed in order to investigate the type of oxidation of Cu nanoparticles (Figure S3). Due to the very good dispersion of the Cu nanoparticles it is difficult to clearly identify peaks, however we observe the peaks of CuO in two different PCC-Cu samples.



Figure S3. X-Ray diffraction (XRD) of PCC-Cu.

Cu 2p X-Ray Photoelectron Spectroscopy was employed in order to investigate the type of oxidation of Ag nanoparticles in PCC-Ag. From the Binding energy of the Ag  $3d_{3/2}$  and Ag  $3d_{5/2}$  (Figure S4) we realize that we don't have AgO which is indicated in lower binding energies<sup>1</sup> but Ag in *ion form as counterions of carboxyl groups of PCC*. The binding energy of Ag 3d was corrected considering the charge shift observed for the carbon carbon bonds centred at 285 eV.



Figure S4. Cu 2p X-Ray Photoelectron Spectroscopy of PCC-Ag.

X-Ray diffraction pattern of PCC-Ag is shown in Figure S5. Due to the ionic form of Ag we cannot observe any other peak apart from the graphitic peak of PCC. This is due to the fact that Ag nanoparticles are not aggregated but are in ionic form well distributed all over the porous carbon material



Figure S5. XRD pattern of PCC-Ag

## 1. A.M. Ferraria et al. Vacuum 86 (2012) 1988e1991

Microscopical observation of microalgal cells interacting with PCC- Ag is shown in Figure S6. It is obvious that PCC-Ag revealed an almost total destruction of the cells, but higher resolution microscopic techniques are necessary to enlighten the mechanisms through which PCC-Ag affect microalgal cells.



Figure S6: Microscope images of *Chlamydomonas reinhardtii* cells under the presence of PCC-Ag after 6 days of interaction