Supplementary materials

Plasmonic fluorescent Ag/C-based nanohybrids for treatment of chemically-induced cutaneous burns

Halyna Kuznietsova,*[a] Iryna Byelinska,[a,b] Arsen Ishchuk,[a] Vladimir Lysenko,[c] Alexander Zaderko,[c] Yury V. Ryabchikov,[e] Olga Pylypova, [a] Kostiantyn Paliienko, [d] and Nataliia Dziubenko[a]

Physicochemical characterization of Ag/C NHs

Size and Z-potential distributions of colloidal Ag/C NHs was additionally determined using a Zetasizer Nano ZS (Malvern Instruments) equipped with a 5 mW He–Ne laser (λ = 633 nm) and a 173° Non-Invasive Back Scatter (NIBS) detector with a narrow-band optical filter.

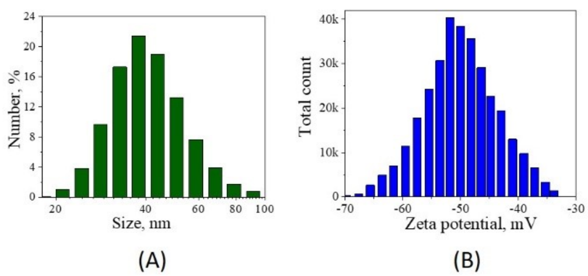


Fig. 1S (A) Size and (B) Z-potential distributions of Ag/C NHs at pH 9.3

Figure 1S shows characteristic size and Z-potential distributions of Ag/C NHs at pH 9.3. As one can see, hydrodynamic diameters of the NHs correspond to the range of 20–100 nm, with a clearly pronounced maximum at around 37 nm. This observation is in good agreement with the TEM pictures. As for the Z-potentials, the most probable values are strongly negative and are in the range -45-55 mV. This indicates on reliable colloidal stability of the solutions with dispersed Ag/C NHs.

FTIR spectrum of carbon phase of the Ag/C NHs are shown in Figure 2S. Broad absorption features in the range 3000–3400 cm⁻¹ can be assigned to stretching vibrations of O–H and N–H groups indicating presence of hydroxyl and amine functionalities. The bands observed in the 2800–2915 cm⁻¹ region can be related to ν(C–H) of sp3 -hybridized alkane bonds. An absorption band near 1640 cm⁻¹ corresponds to C–O–C stretching and conjugated carbonyl (C=O) vibrations, while the band around 1600 cm⁻¹ can be associated with aromatic C=C vibrations. The band at 1544 cm−1 could be related to ν(C = N) stretches in conjugated systems or indicates the presence of amide groups. An absorption band centered at 1400 cm−1 is characteristic for C–O vibrations of carboxylic acid. The peak near 1090 cm⁻¹ is indicative of C-N single-bond stretching vibration. In the 700–760 cm⁻¹ region, aromatic C–H bending vibrations are also observed.

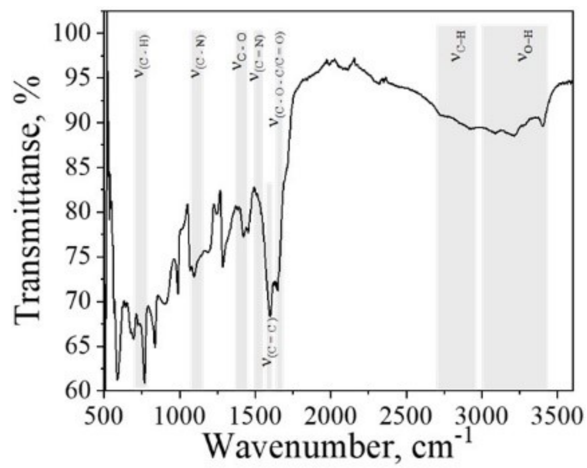


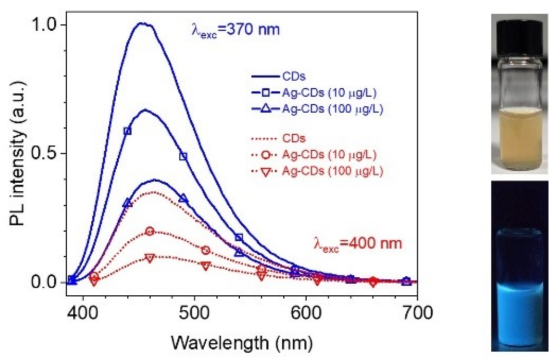
Fig. 2S FTIR spectrum of C phase of Ag/C NHs.

Optical properties of Ag/C NHs

To study changes in optical properties of the formed Ag/C NHs, they were investigated by UV-Vis and PL spectroscopy. One can see considerable differences of absorbance spectra of CDs and Ag/C NHs solutions. Indeed, a smaller amount of Ag (10 μg/L) led to broadening of the spectrum due to appearance of additional peak at around 400 nm. It is associated with plasmonic absorption of silver nanostructures in Ag/C NHs. Moreover, higher intensity of this peak can point to stronger absorption due to larger silver content. Furthermore, increasing of absorption of Ag/C NHs also led to a weaker photoluminescence excitation (PLE) efficiency (Figure 3S).

a. *Institute of High Technologies, Taras Shevchenko National University of Kyiv, Volodymyrska str. 64/13, 01601 Kyiv, Ukraine.*
b. *Educational and scientific center "Institute of Biology and Medicine", Taras Shevchenko National University of Kyiv, Volodymyrska str. 64/13, 01601 Kyiv, Ukraine.*
c. *Universite Claude Bernard Lyon 1, CNRS, Institut Lumière Matière, UMR5306, 69100 Villeurbanne, France.*
d. *Universite Claude Bernard Lyon 1, CNRS, Ingénierie des Matériaux Polymères, UMR5223, 69100 Villeurbanne, France*
e. *HiLASE Centre, Institute of Physics of the Czech Academy of Sciences, Za Radnicí 828, 252 41 Dolní Břežany, Czech Republic.*
† Footnotes relating to the title and/or authors should appear here.
Supplementary Information available: [details of any supplementary information available should be included here]. See DOI: 10.1039/x0xx00000x

As a result, PL intensity of Ag/C NHs decreased with increasing of Ag content as compared to bare CDs (Figure 3S). This tendency was found for different excitation wavelength: 370 nm and 400 nm. These wavelengths were chosen based on aforementioned absorbance study (Figure 6): the first excitation wavelength is associated with absorption maximum of CDs while the second one is related



(A) (B)

to plasmonic maximum of Ag nanoparticles.

Fig. 3S PL spectra of CDs with different amount of plasmonic (Ag) metal excited at 370 nm and 400 nm (A); Photos of colloidal Ag/C NHs in daylight and under the UV-light illumination (B).

The obtained results demonstrate remarkable influence of plasmonic metallic content on optical properties of the Ag/C NHs.