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Supporting information

for

Cytocompatible cerium oxide-mediated antioxidative stress in inhibiting ocular inflammation-associated corneal neovascularization

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Material preparation

Different strategies, including hydrothermal processes and microemulsion methods, were used to prepare CeNPs[1-3]. First, 10 mL of a 0.1 M cerium (III) nitrate was mixed with 10 mL of 0.5 N aqueous ammonia, stirred well, placed in an oven, and evaporated to dryness at 95 °C. The resulting CeNPs powder was taken out and sintered at 300 °C for 1 hour. The cooled resulting dust was transferred to a stainless steel autoclave (100 mL), and a 2.0 N aqueous sodium hydroxide solution was added to 80% of the reactor volume, which was autoclaved at 120 °C for 24 hours. After cooling to room temperature, the mixture in the autoclave was removed and titrated to pH 7.0 using hydrochloric acid. After dialysis, the sample was lyophilized to yield CeNPs.

The microemulsion method was as follows: The surfactant sodium bis(2-ethylhexyl) sulfosuccinate (AOT) 0.1556 g was dissolved in 50 mL of toluene; then, 2.5 mL of a 0.1 M aqueous solution of lanthanum nitrate was added. After the solution was stirred for 45 minutes, 5 mL of 30% hydrogen peroxide was added dropwise. The reaction was carried out for one h and allowed to stand for stratification. The lower layer consisted of the precipitated aqueous phase and agglomerated CeNPs and was discarded. The upper layer consisted of toluene and dispersed CeNPs, which were spun at 130 °C overnight.

Besides the method in the full-text, we refer to various strategy to obtain

cerium oxide nanoparticles(Figure S1). After preparation and comparison, the prepared cerium oxide nanoparticle (20nm, CeNPs II) with high yield, natural purification, and good stability was chosen to constitute a multi-scale sample for subsequent evaluation.

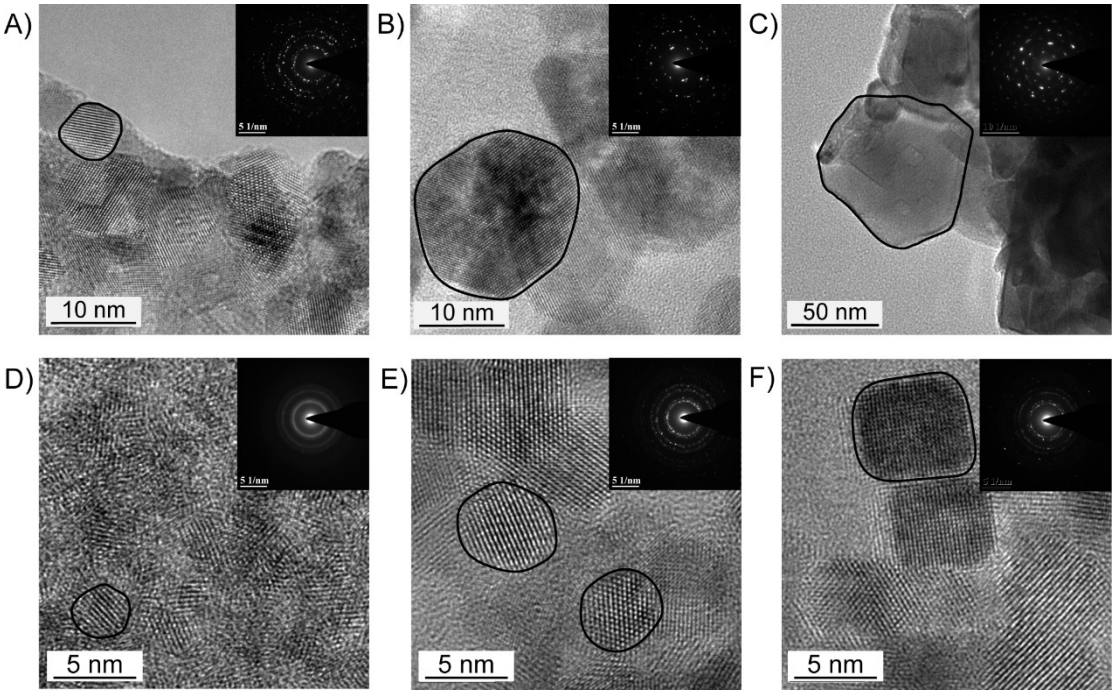

Figure S1. Morphology characterization of CeNPs by high resolution TEM and SAED images. (A)commercialized CeNPs with 10nm-scale (CeNPs I); (B)hydrophilic particles with 20nm-scale, named CeNPs II; (C)commercialized CeNPs with 100nm-scale (CeNPs III); (D)CeNPs prepared by microemulsion method, AOT removal was difficult; (E)CeNPs prepared by hydrothermal processes method, low yield and poor stability in water; (F)hydrophilic CeNPs with 5nm-scale. The potential toxicity caused by stability and surfactant residues is an essential basis for our choice of cerium oxide nanoparticles for subsequent experiments.

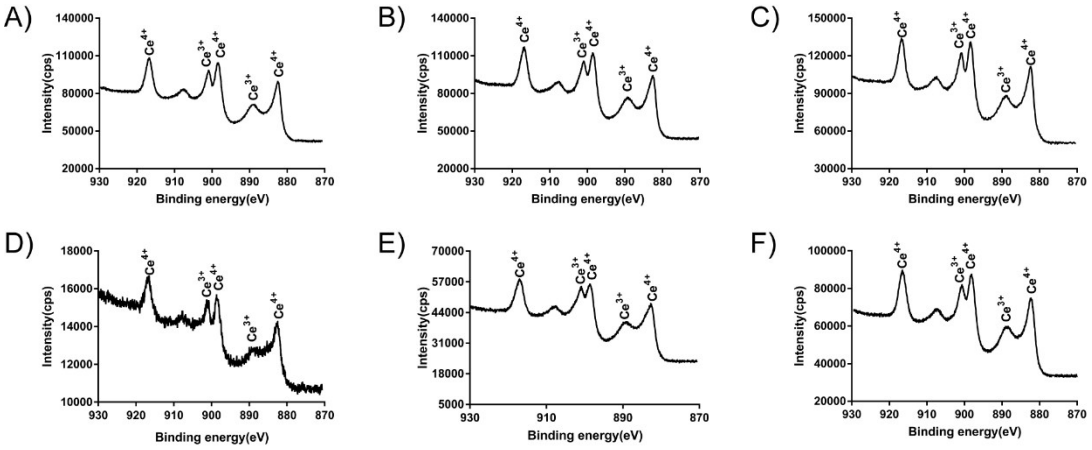

Figure S2. XPS spectrum of various CeNPs prepared via different methods. (A) commercialized CeNPs with 10nm-scale (CeNPs I), Ce^{3+}/Ce^{4+} was 0.42; (B) Hydrophilic particles with 20nm-scale, named CeNPs II, Ce^{3+}/Ce^{4+} was 0.19; (C) commercialized CeNPs with 100nm-scale (CeNPs III) , Ce^{3+}/Ce^{4+} was 0.3; (D)CeNPs prepared by microemulsion method, Ce^{3+}/Ce^{4+} was 0.46; (E) CeNPs prepared by hydrothermal processes method, Ce^{3+}/Ce^{4+} was 0.38; (F) hydrophilic CeNPs with 5nm-scale, Ce^{3+}/Ce^{4+} was 0.21.

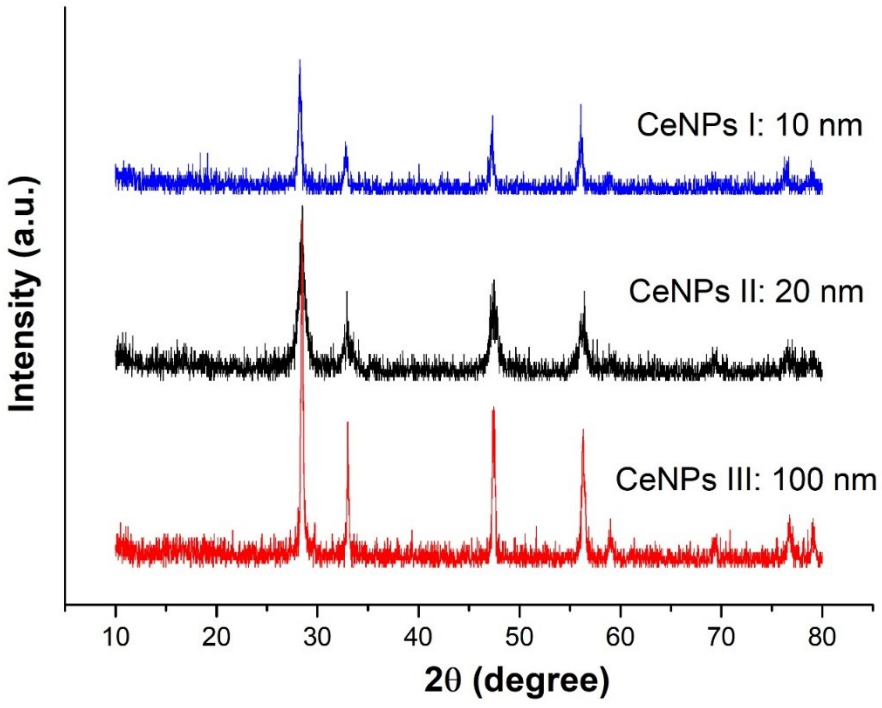

Figure S3. XRD patterns of (blue, top) CeNPs I: 10nm, (black,middle) CeNPs II: 20nm, (red, bottom) CeNPs III: 100nm.

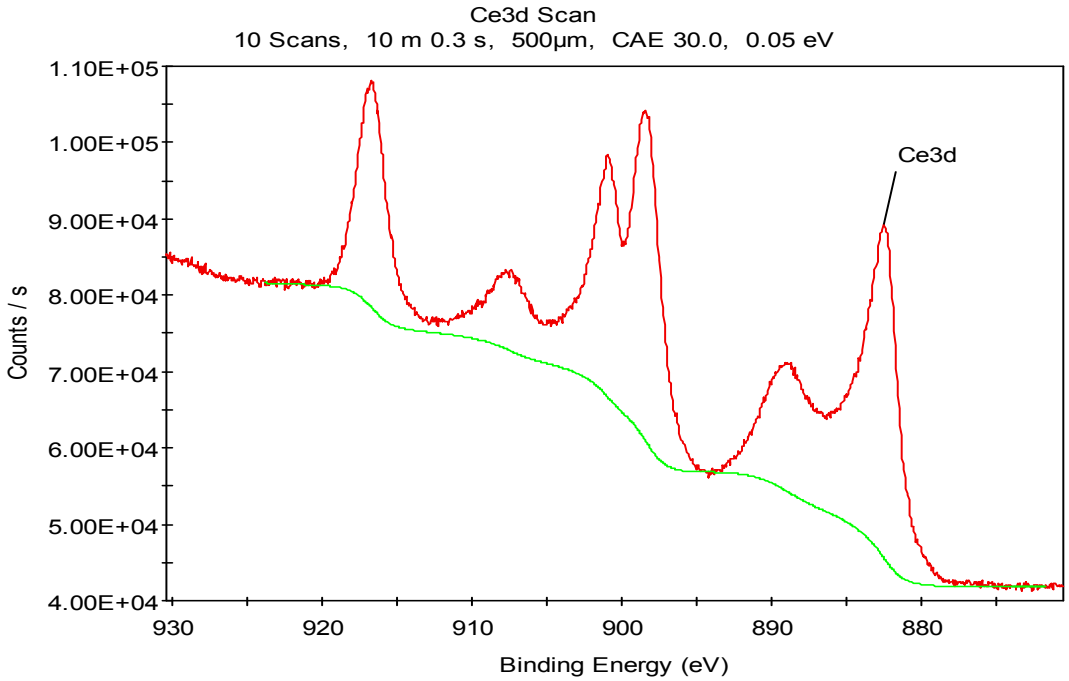

Figure S4. XPS spectra of CeNPs I: 10nm.

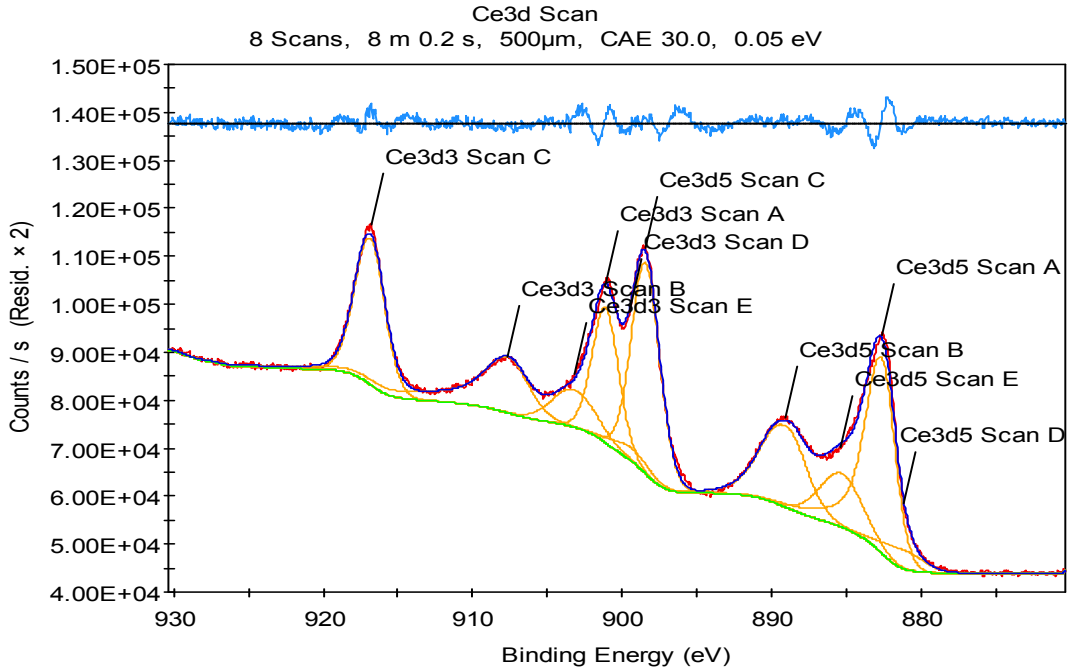

Figure S5. XPS spectra of CeNPs II: 20nm.

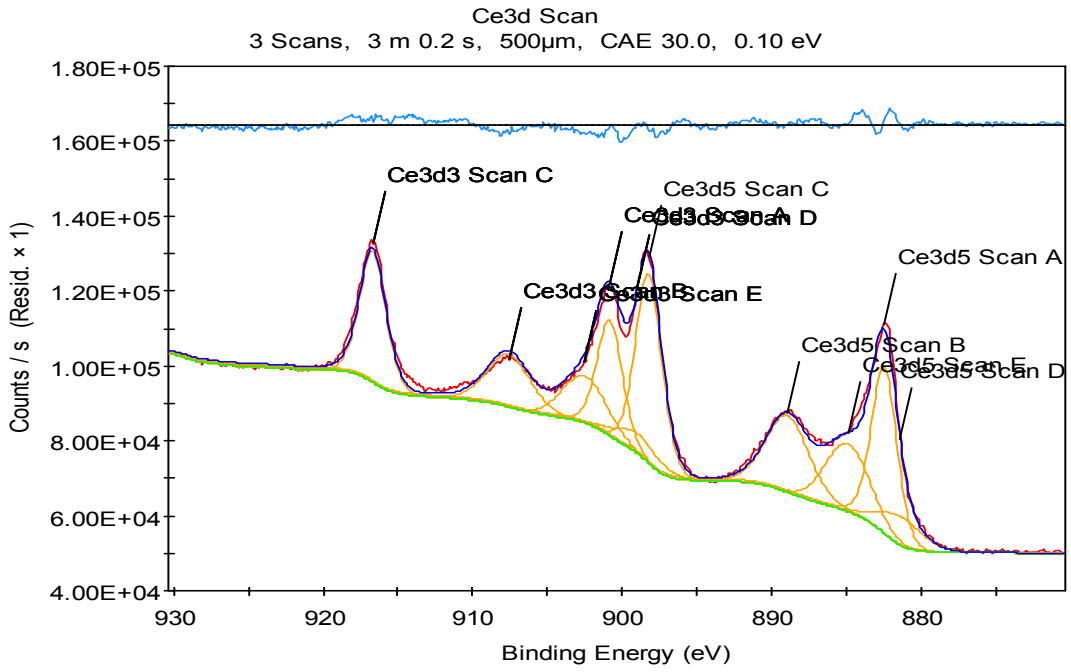

Figure S6. XPS spectra of CeNPs III: 100nm.

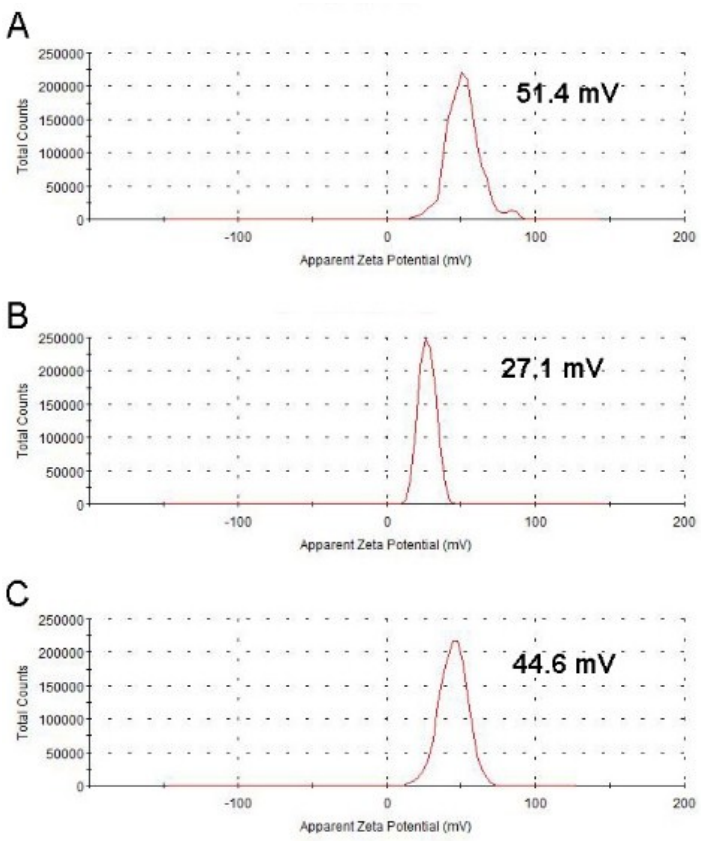

Figure S7.The surface charges of CeNPs were characterized by zeta potential measurements and were shown in (A)CeNPs I, ζ=51.4 mV, (B) CeNPs II, ζ=24.5 mV and (C) CeNPs III, ζ=44.6 mV, respectively.

References

1. C. Korsvik, S. Patil, S. Seal and W. T. Self, *Chemical Communications*, 2007, 1056-1058.

2. S. Patil, S. Kuiry, S. Seal and R. Vanfleet, *Journal of Nanoparticle Research*, 2002, **4**, 433-438.

3. G.-M. Lyu, Y.-J. Wang, X. Huang, H.-Y. Zhang, L.-D. Sun, Y.-J. Liu and C.-H. Yan, *Nanoscale*, 2016, **8**, 7923-7932.