Supporting Information

Action Potentials as a Mean to Trigger the Specific Interaction of Negatively-Charged Nanoparticles with Electrical Excitable Cells

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Figure S1. TEM image of as-synthesized CdSe/CdS nanoparticles of size 33±6 nm length and 5.0±0.5 width, dispersed in toluene.
Figure S2. PL spectra of water-soluble CdSe/CdS nanoparticles excited at 488 nm.
Figure S3. Confocal images of neurons interacting with CdSe/CdS at different concentrations: 0.1 nM (A), 1 nM (B), 15 nM (C). Scale bar 50 µm
Figure S4. Bright field images corresponding to the confocal images showing NP-neurons interaction over time reported in Figure 2. Scale bar 50 µm.
Figure S5. (A) Undifferentiated and (B) differentiated N2a cells. Differentiation was obtained after addition of retinoic acid (20 µM) in cell culture medium and observed after 48 hours.
**Figure S6** Confocal images of N2a neuron cells interacting with less negative NPs (-11 mV). No NPs interaction (no red signal) was observed for both undifferentiated N2a (A) and differentiated N2a (B). Cell nuclei were stained with DAPI. Scale bar 50 µm.
Figure S7. Confocal images of neurons interacting with a gradient of charged NPs. In order: -50, -18, -8, +11 mV. Scalebar: 50 μm (reprinted from B.Salis PhD Thesis, https://hdl.handle.net/11567/939837).
**Figure S8.** Photographs of Nile red micelles synthesizing reaction mixtures, during each step of its preparation.

**Figure S9.** Average surface zeta potential $-26\pm6$ mV of Nyle-red encapsulated micelles in water.
Figure S10. The mean hydrodynamic sizes of Nile-Red encapsulated micelles dispersed in water. The standard deviation values presented were from the full-width half maxima (FWHM) of the peaks.

<table>
<thead>
<tr>
<th>Micelles-NR</th>
<th>Intensity %</th>
<th>Number %</th>
<th>Volume %</th>
<th>PDI</th>
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<tr>
<td>76±21 nm</td>
<td>53±13 nm</td>
<td>64±19 nm</td>
<td>0.058</td>
<td></td>
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Figure S11. A) Additional TEM image of polymeric micelles encapsulated with Nile-red dye. B) The size distribution histogram of the same micelles was obtained by statistically measuring the objects on TEM images.
Figure S12. Subsequent frames of the interaction between neurons and negative NPs ($\zeta = -50$ mV) at time 0, 6, 16 and 24 and 40 seconds. Scalebar: 50 $\mu$M. The two magnifications show in details the initial and final images of the video (reprinted from B.Salis PhD Thesis, https://hdl.handle.net/11567/939837).
Figure S13. Subsequent frames of the real-time interaction between neurons and polymeric micelles ($\zeta = -26$ mV) at $t= 0, 6, 15, 30$ seconds. Scale bar: 50 $\mu$m. The two magnifications show in detail the initial and final images of the video (reprinted from B.Salis PhD Thesis, https://hdl.handle.net/11567/939837).