Click Functionalized Biocompatible Gadolinium Oxide Core-shell Nanocarriers for Imaging of Breast Cancer Cells

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Figure S1: TEM images of iron oxide particles with different magnification A-B oleic acid-capped Fe₃O₄ nanospheres, C-D Fe₃O₄ NPs after the removal of oleic acid
Figure S2: A-B: TEM images with different magnification of SiO$_2$@Fe$_3$O$_4$(cubes) NPs, C- SEM image of SiO$_2$@Fe$_3$O$_4$(spheres) NPs, and D- TEM image of Gd$_2$O$_3$@SiO$_2$@Fe$_3$O$_4$(spheres) showing the clear demarcation of thin layer of gadolinium oxide (15± 5 nm) on core shell structure.
Figure S3: A-B- TEM Images of Gd$_2$O$_3$@SiO$_2$@Fe$_3$O$_4$(cubes) nanocarriers C- High resolution TEM of Gd$_2$O$_3$@SiO$_2$@Fe$_3$O$_4$(cubes) carriers (the inset for SAED pattern), and D- EDX analysis of Gd$_2$O$_3$@SiO$_2$@Fe$_3$O$_4$(cubes) nanocarriers
Figure S4: A-D- Dynamic light scattering of the nanocarriers (cube shaped iron oxide as a core) in water showed an increase in average hydrodynamic diameter of nanocarriers after different conjugation steps. E-H- Zeta potential measurements displayed a change in surface charge after the attachment of different molecule used for the conjugation of estrogen molecules.
Table S1: DLS and Zeta potential

<table>
<thead>
<tr>
<th>Nanocarriers</th>
<th>DLS (d.nm)</th>
<th>Zeta potential (mV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gd$_2$O$_3$@SiO$_2$@Fe$_3$O$_4$ (cube as a core)</td>
<td>165 ±7</td>
<td>-10.1</td>
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<tr>
<td>APTM-Gd$_2$O$_3$@SiO$_2$@Fe$_3$O$_4$</td>
<td>259 ±11</td>
<td>+11.6</td>
</tr>
<tr>
<td>Br-Gd$_2$O$_3$@SiO$_2$@Fe$_3$O$_4$</td>
<td>251 ±17</td>
<td>-13.0</td>
</tr>
<tr>
<td>estrogen-Gd$_2$O$_3$@SiO$_2$@Fe$_3$O$_4$</td>
<td>595 ±11</td>
<td>-15.8</td>
</tr>
</tbody>
</table>

Figure S5: XRD diffraction pattern of Gd$_2$O$_3$@SiO$_2$@Fe$_3$O$_4$ NPs after conjugation of estrogen via click reaction. The references for magnetite (JCPDS C72-2303) is in green, and for Gd$_2$O$_3$ (JCPDS C12-0797) in blue.
Figure S6: Flow cytometry measurements of FITC conjugated bare-Gd₂O₃@SiO₂@Fe₃O₄ carriers with breast cancer cell line MCF7.
Figure S7: Flow cytometry measurements of pure MCF7 breast cancer cells without the addition of nanocarriers.

Figure S8: Dynamic light scattering of the nanocarriers (spherical iron oxide as a core) in water showed an increase in average hydrodynamic diameter of nanocarriers as compared to TEM analysis. Zeta potential measurements displayed a negative charge when no surface linker or ligand is attached.