Supplementary Material

Iron oxide nanoflowers @ CuS hybrids for cancer tri-therapy: interplay of photothermal therapy, magnetic hyperthermia and photodynamic therapy

Alberto Curcio,[//†] Amanda K. A. Silva,[†] Sonia Cabana,[//†] Ana Espinosa,[†] Benoit Baptiste,[§] Nicolas Menguy,[§] Claire Wilhelm[†*‡] and Ali Abou-Hassan[//*‡]

[//] Sorbonne Université, CNRS UMR 8234, Physicochimie des Electrolytes et Nanosystèmes InterfaciauX (PHENIX), 4 place Jussieu, 75005 Paris, France.

[†] Laboratoire Matière et Systèmes Complexes, CNRS UMR 7057, Université Paris Diderot, 75205 Paris Cedex 13, France.

[§] Sorbonne Université, MNHN, CNRS UMR 7590, IRD - Institut de Minéralogie de Physique des Matériaux et de Cosmochimie (IMPMC), 4 place Jussieu, 75005 Paris, France.

[‡] Equal contribution

* Mail to ali.abou_hassan@sorbonne-universite.fr; claire.wilhelm@univ-paris-diderot.fr

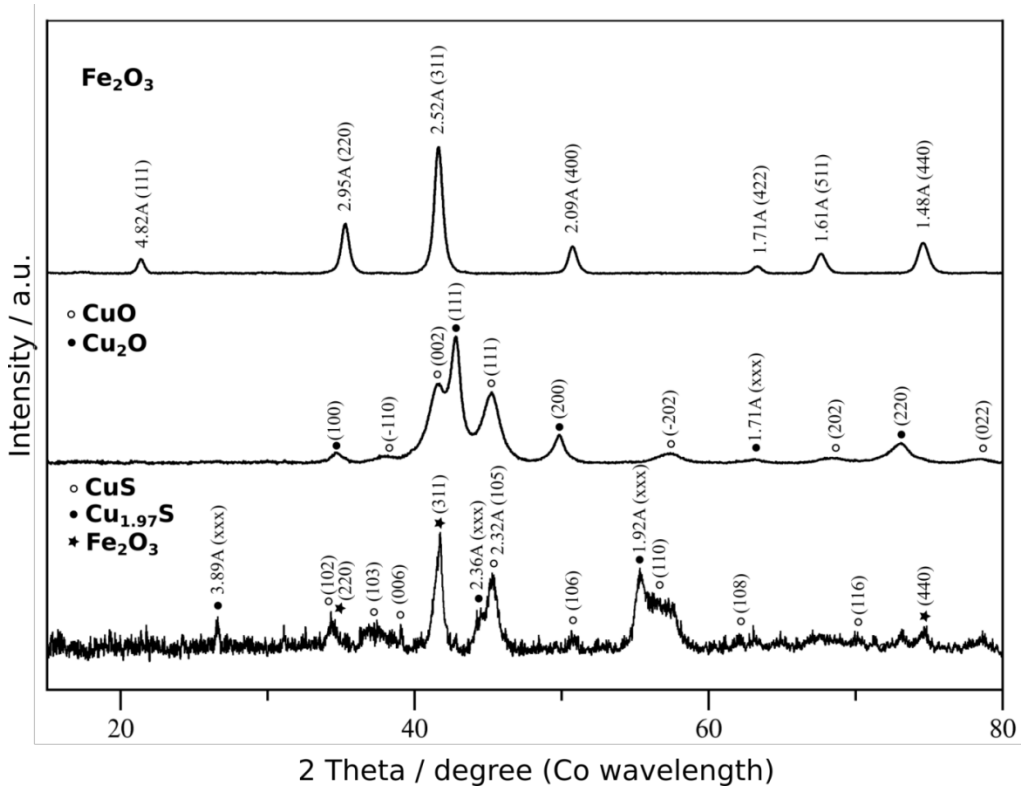

Figure S1. X-ray diffraction diagrams of the spiky IONF@CuS using a Co *K*α radiation showing the presence of maghemite Fe_2O_3 (PDF2 card no. 00-039-1346), tenorite CuO (PDF2 card no. 00-041-0254), cuprite Cu_2O (PDF2 card no. 01-071-4310), covellite CuS (PDF2 card no. 00-006-0464), and $Cu_{2-x}S$ (consistent with PDF2 card of djurleite no. 01-071-1383).

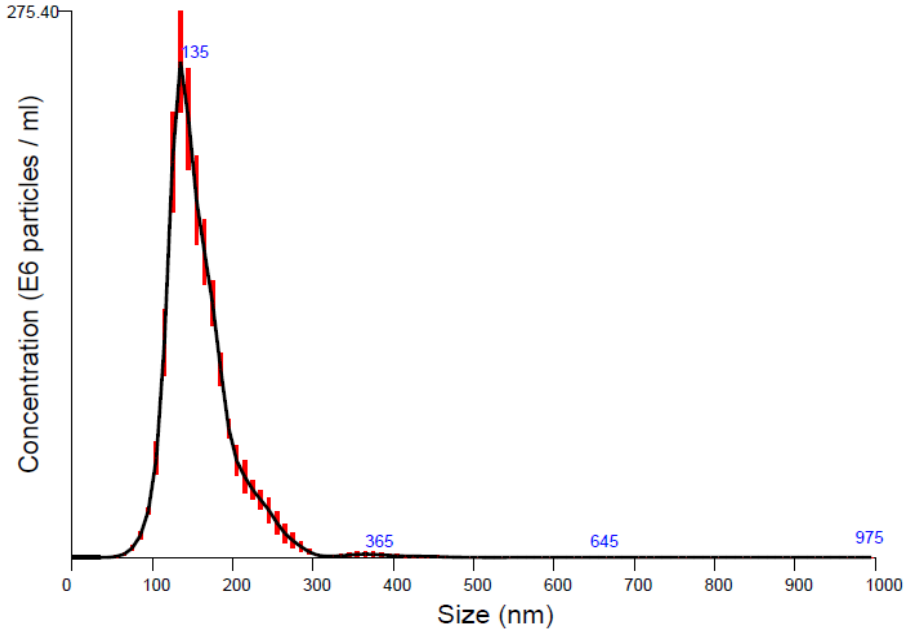

Figure S2. Nanoparticle Tracking Analysis (NTA) of spiky IONF@CuS in water having the main dimeter peak at 135 nm and with a mean diameter of 154.6 nm.

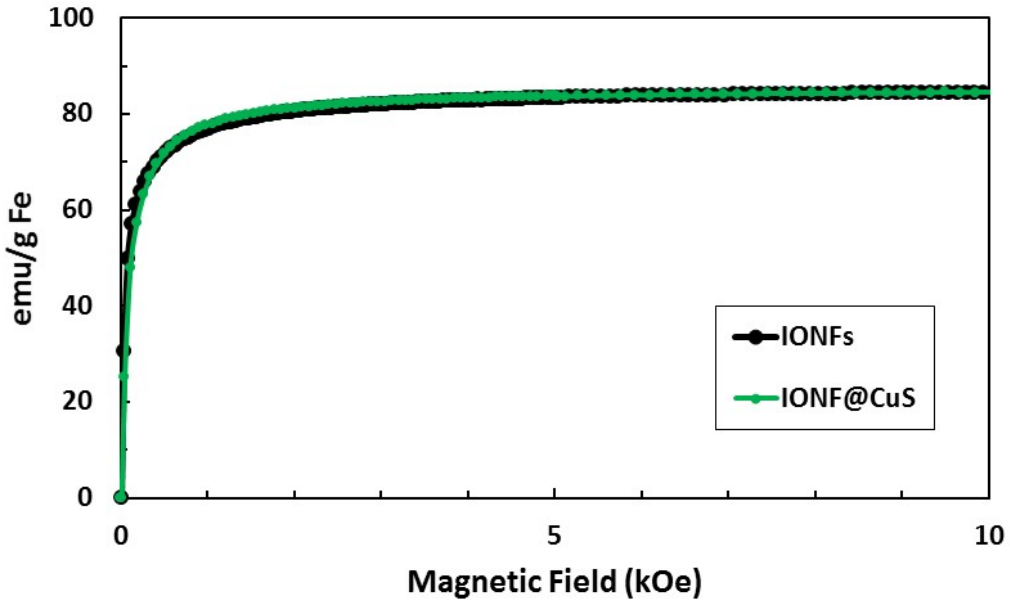

Figure S3. Magnetic properties of the magnetic iron oxide nanoflowers (IONFs) core alone, and after coating with the CuS shell. The shell does not impact neither the saturation magnetization (84 emu g^{-1} of Fe) nor the initial magnetic susceptibility.

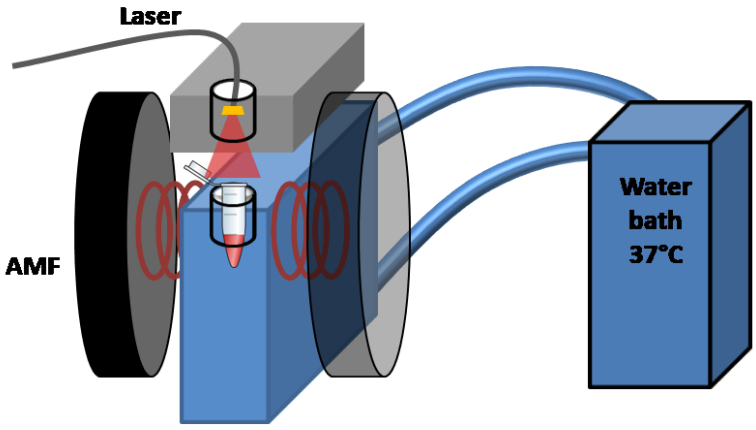

Figure S5: Sketch drawing of the thermostated support used to apply simultaneously AMF and Laser.

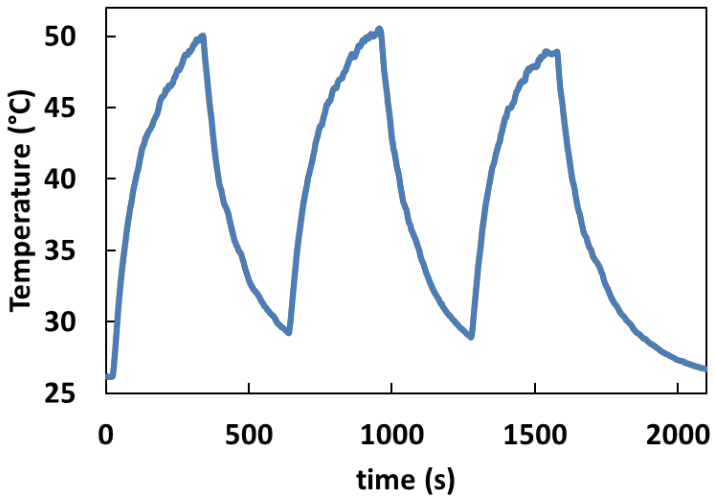

Figure S5. Multiples heating cycles of the IONF@CuS water dispersion at the concentration of 80 mM Cu illuminated by 1064 nm laser at 0.3 W cm^{-2} for 5 min on and 5 min off, showing the nanoparticles stability during PTT.

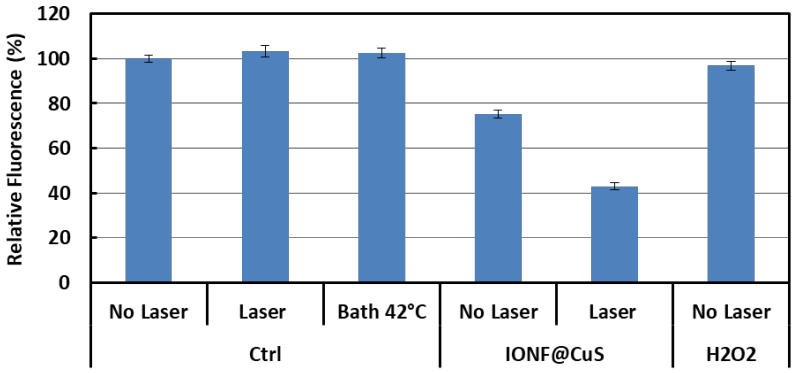

Figure S6: Selective detection of the superoxide radical ($^{\bullet}O_2^-$) in presence of IONF@CuS nanohybrids ([Cu] = 130 µM) and an applied 1064 nm laser (5 min exposure at 1 W cm^{-2}) using the specific probe 1,3-diphenylisobenzofuran (DPBF, λ_{ex} = 410 nm; λ_{em} = 477 nm). H_2O_2 at the concentration of 1.8 mM have been used to prove the specificity of the analysis toward the superoxide.

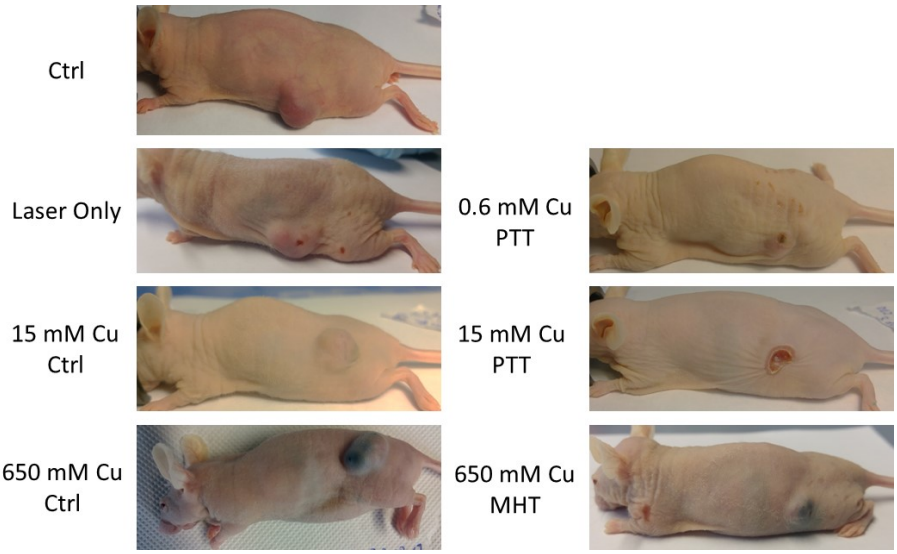

Figure S7: Representative photographs of tumor-bearing mice 13 days after treatment.