Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B.

Supporting information

Designer DNA-Silica/Carbon Nanotube Nanocomposites for Traceable and Targeted Drug Delivery

Yong Hu and Christof M. Niemeyer*

Karlsruhe Institute of Technology (KIT), Institute for Biological Interfaces (IBG 1), Hermann-von-Helmholtz-Platz 1, 76344, Eggenstein-Leopoldshafen, Germany

* To whom correspondence should be addressed. E-mail address: niemeyer@kit.edu (C. M. Niemeyer)

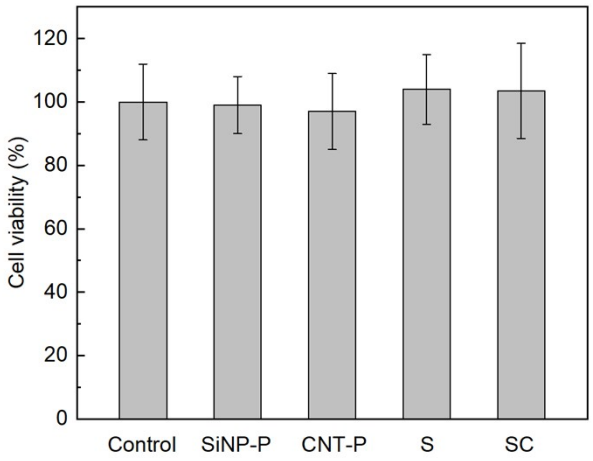

Figure S1. Viability of HeLa cells after incubated with SiNP/CNT-DNA nanocomposite materials. Cell viability of HeLa cells treated with PBS (control), SiNP-P, CNT-P, S and SC for 24 h, respectively, as determined by the CCK-8 assay.

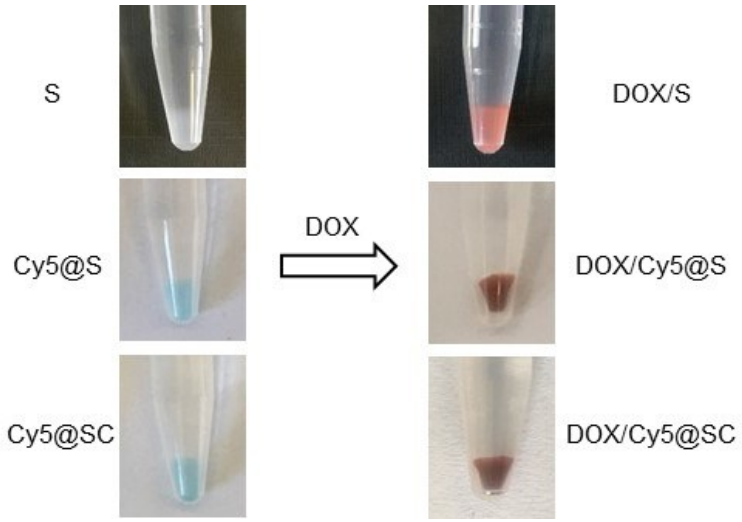

Figure S2. SiNP/CNT-DNA nanocomposite materials before and after DOX loading. Photographs of S, Cy5@S and Cy5@SC nanocomposites before and after DOX loading. The Cy5@S and Cy5@SC materials were prepared from fluorescent dye Cy5-containing core/shell SiNP.[1]

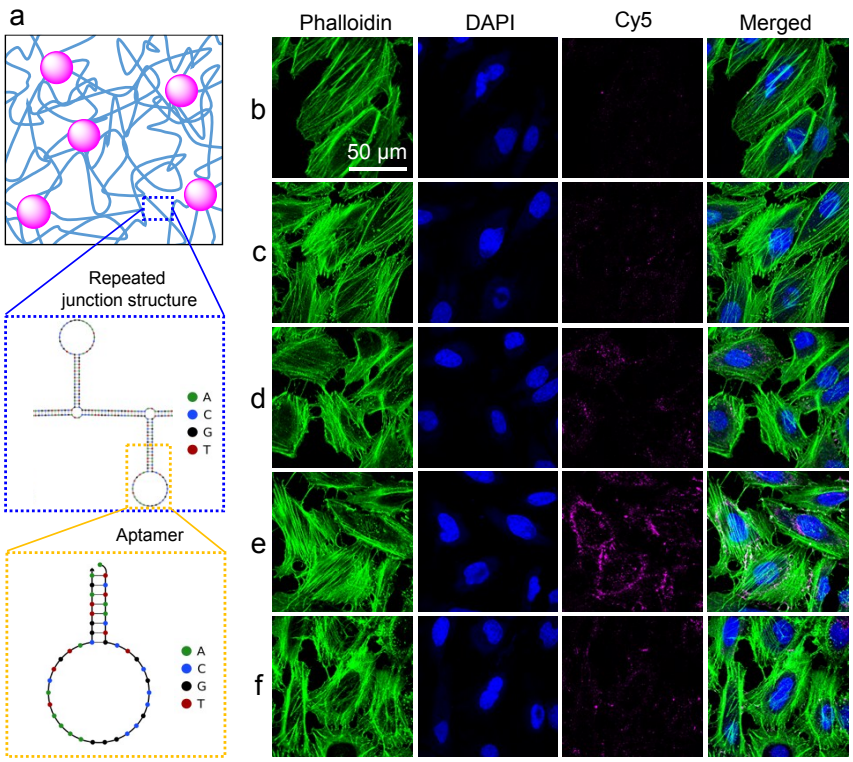

Figure S3. Aptamer-mediated uptake of SiNP-DNA nanocomposites into HeLa cells. (a) Secondary structure of the RCA product obtained from circular template T. The structures were predicted using the Nupack software.[2] Note the presence of the Sgc8 aptamer structures (5'-ATCTAACTGCTGCGCCGCCGGGAAAATACTGTACGGTTAGA-3') protruding from the backbone. The Sgc8 aptamer specifically binds to PTK7 receptors overexpressed on many cancer cells.[3, 4] (b-f) Confocal fluorescence microscopy images of PTK7-positive HeLa cells treated with fluorescent Cy5@S materials that were produced by RCA polymerization for variable times: 0 h (b), 2 h (c), 4 h (d), or 6 h (e). For control, cells in (f) were treated with 10 μM of the free aptamer. In all cases, the final concentration of Cy5-labeled SiNP was 400 μg/mL. Note that increasing polymerization times, and thus increasing amounts of incorporated aptamers, lead to an increase in Cy5 fluorescence (magenta). Filamentous actin and nuclei were stained with Alexa Fluor 488 Phalloidin (green) and DAPI (blue), respectively.

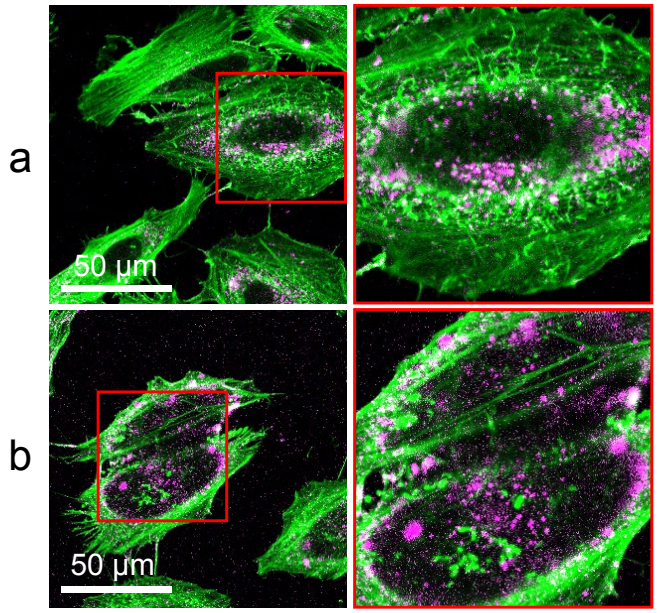

Figure S4. High resolution microscopy analysis of the cellular uptake of DOX-loaded nanocomposite materials. Representative confocal microscopy images of HeLa cells treated with (a) DOX/Cy5@S and (b) DOX/Cy5@SC. These are high resolution magnifications of the images shown in Figure 4c, d in the main text. The DOX channel (red) is omitted here for clarity. HeLa cells were incubated with the Cy5 (magenta)-labeled materials for 2 h, washed to remove excess materials, fixed and subjected to staining of the filamentous actin with Alexa Fluor 488 Phalloidin (green). The right panel shows magnifications of the red framed regions of the images in the left panel. Note that it is clearly evident that the Cy5-labeled DNA composites (magenta) are localized in the cell's cytoplasm and the inner side of the cell membrane (green), thereby indicating that both drug delivery systems were efficiently ingested by cells.

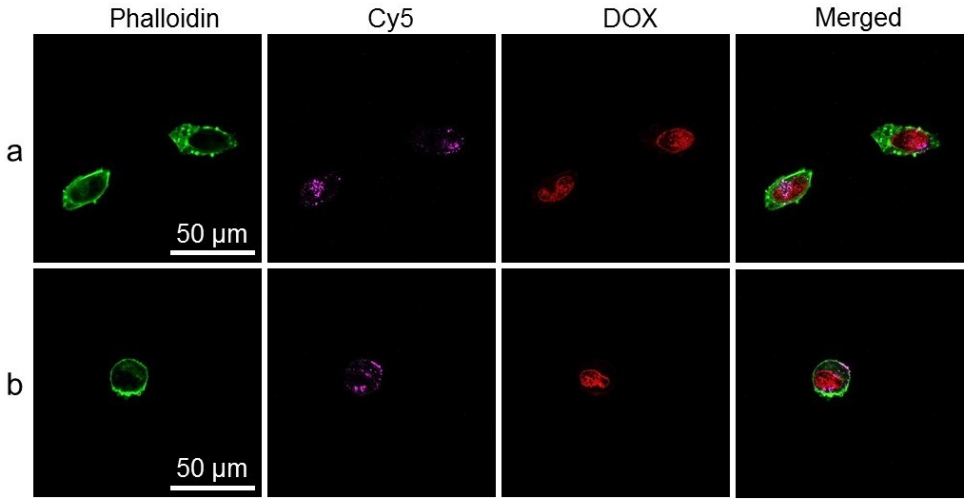

Figure S5. Traceable drug delivery to PTK7-positive HeLa cells. Representative confocal microscopy images of HeLa cells treated with (a) DOX/Cy5@S and (b) DOX/Cy5@SC. HeLa cells were incubated with the materials for 2 h, washed to remove excess materials, cultivated for another 24 h, fixed and subjected to staining of the filamentous actin with Alexa Fluor 488 Phalloidin (green). Note that, in both experimental groups, HeLa cells exhibit a round shape and significant loss of filamentous actin fibers, thus indicating the induction of apoptosis by the ingested DOX.

Table S1. List of DNA sequences.

Name	Sequence (5'-3')	Modification
P1	TCTAACTGCTGCGCCGCCGGGAAAATACTGTACGGTTAGA	-
aP1	[AmC12]TCTAACTGCTGCGCCGCCGGGAAAATACTGTACGG TTAGA	5'Amine C12
P2	TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTCTAA CTGCTGCGCCGCCGGGAAAATACTGTACGGTTAGA	-
T	[Phos]TTCCCGGCGGCGCAGCAGTTAGATGCTGCTGCAGCGA TACGCGTATCGCTATGGGTAACCGTACGGTTACCCGCAGCA GCATCTAACCGTACAGTATT	5' Phosphorylation
Sgc8 aptamer	ATCTAACTGCTGCGCCGCCGGGAAAATACTGTACGGTTAGA	-

References

1. A. Leidner, S. Weigel, J. Bauer, J. Reiber, A. Angelin, M. Grösche, T. Scharnweber and C. M. Niemeyer, *Adv. Funct. Mater.*, 2018, **28**, 1707572.
2. J. N. Zadeh, C. D. Steenberg, J. S. Bois, B. R. Wolfe, M. B. Pierce, A. R. Khan, R. M. Dirks and N. A. Pierce, *J. Comput. Chem.*, 2011, **32**, 170-173.
3. G. Zhu, R. Hu, Z. Zhao, Z. Chen, X. Zhang and W. Tan, *J. Am. Chem. Soc.*, 2013, **135**, 16438-16445.
4. D. Shangguan, Y. Li, Z. Tang, Z. C. Cao, H. W. Chen, P. Mallikaratchy, K. Sefah, C. J. Yang and W. Tan, *Proc. Natl. Acad. Sci. U. S. A.*, 2006, **103**, 11838-11843.