Electronic Supplementary Material (ESI) for Nanoscale.


# Anticancer and antibacterial properties of carbon nanotubes are governed by their functional groups

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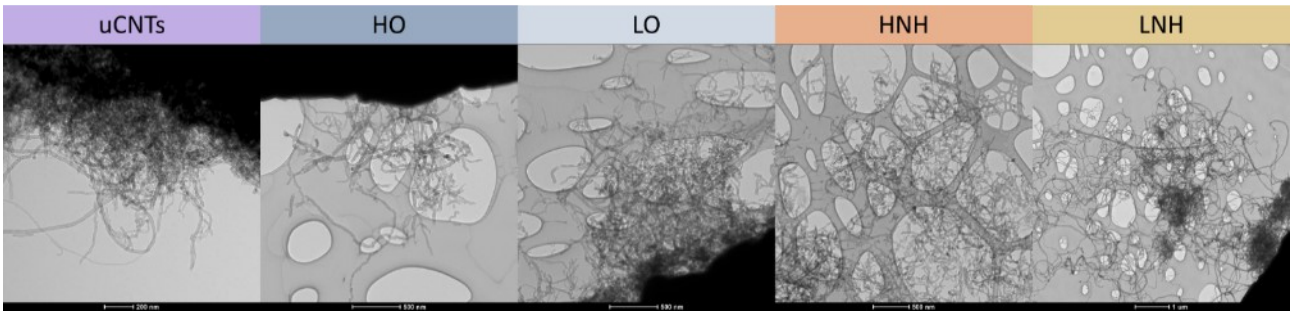
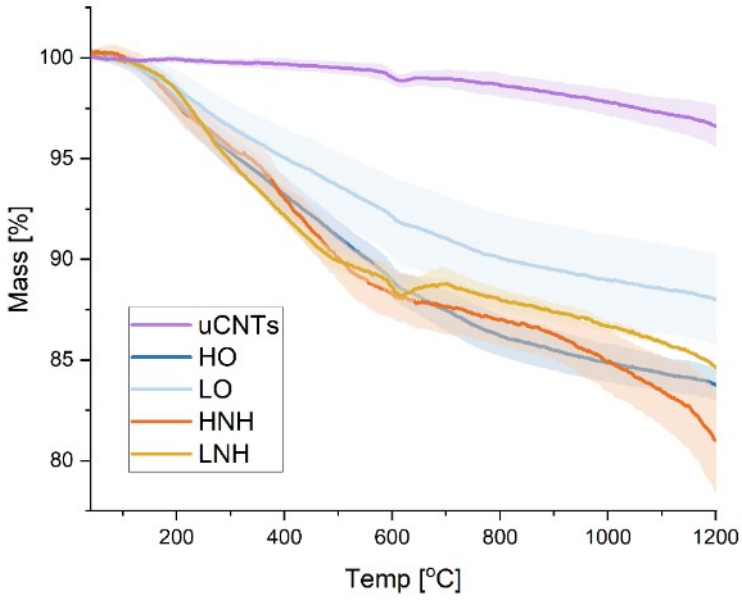
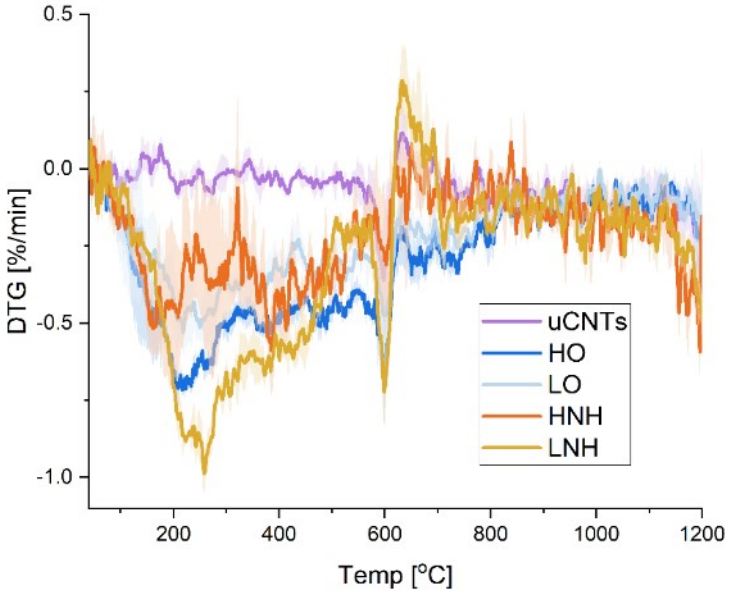



*SM 1 Low magnification TEM images of the CNTs used in this study: unmodified (uCNTs), two types of oxidized: HO and LO, and their amidized derivatives: HNH and LNH, respectively.*



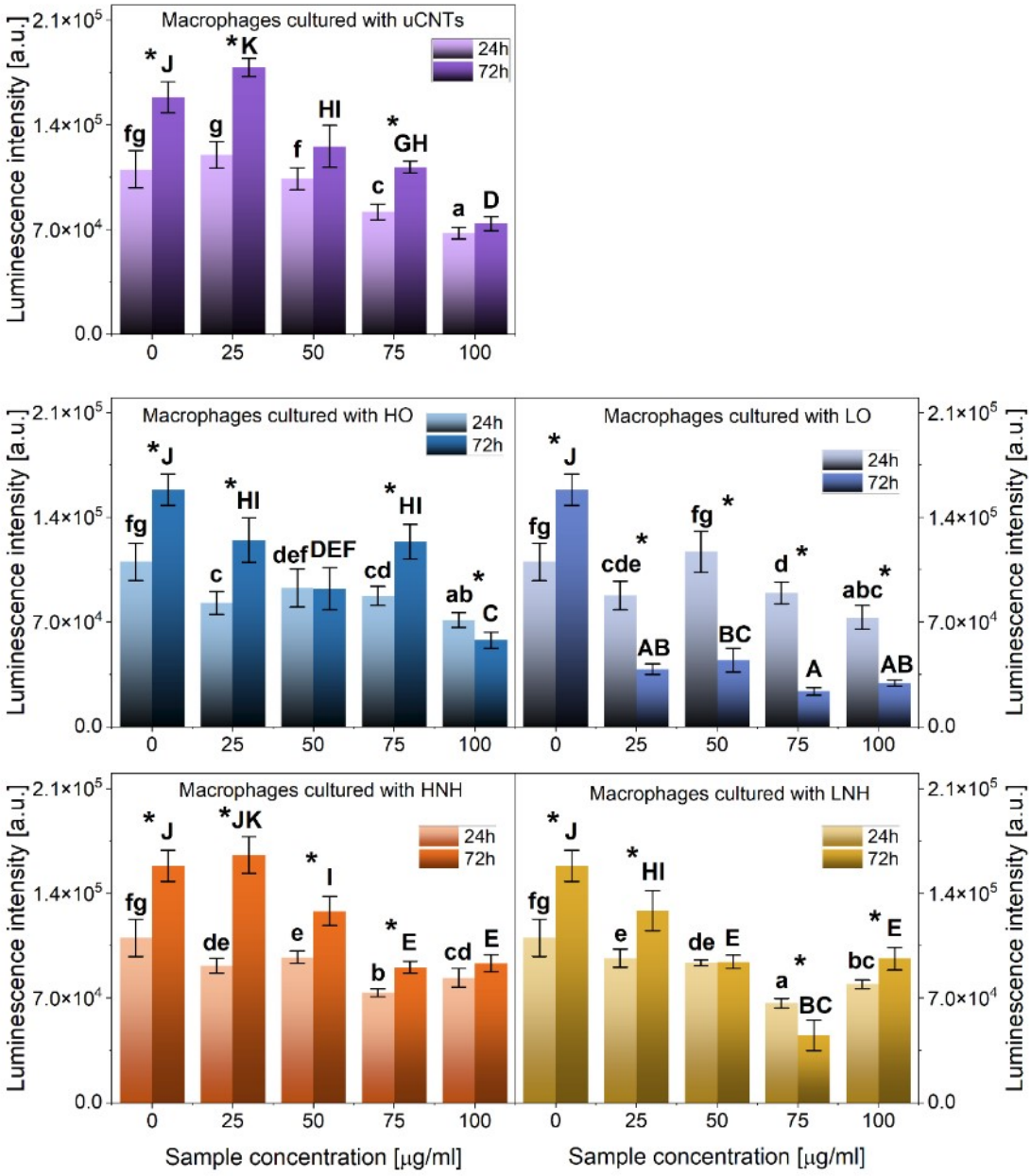

*SM 2 Averaged TG plots of 3 separate measurements conducted on different CNTs types, presented along with the standard deviation values.*



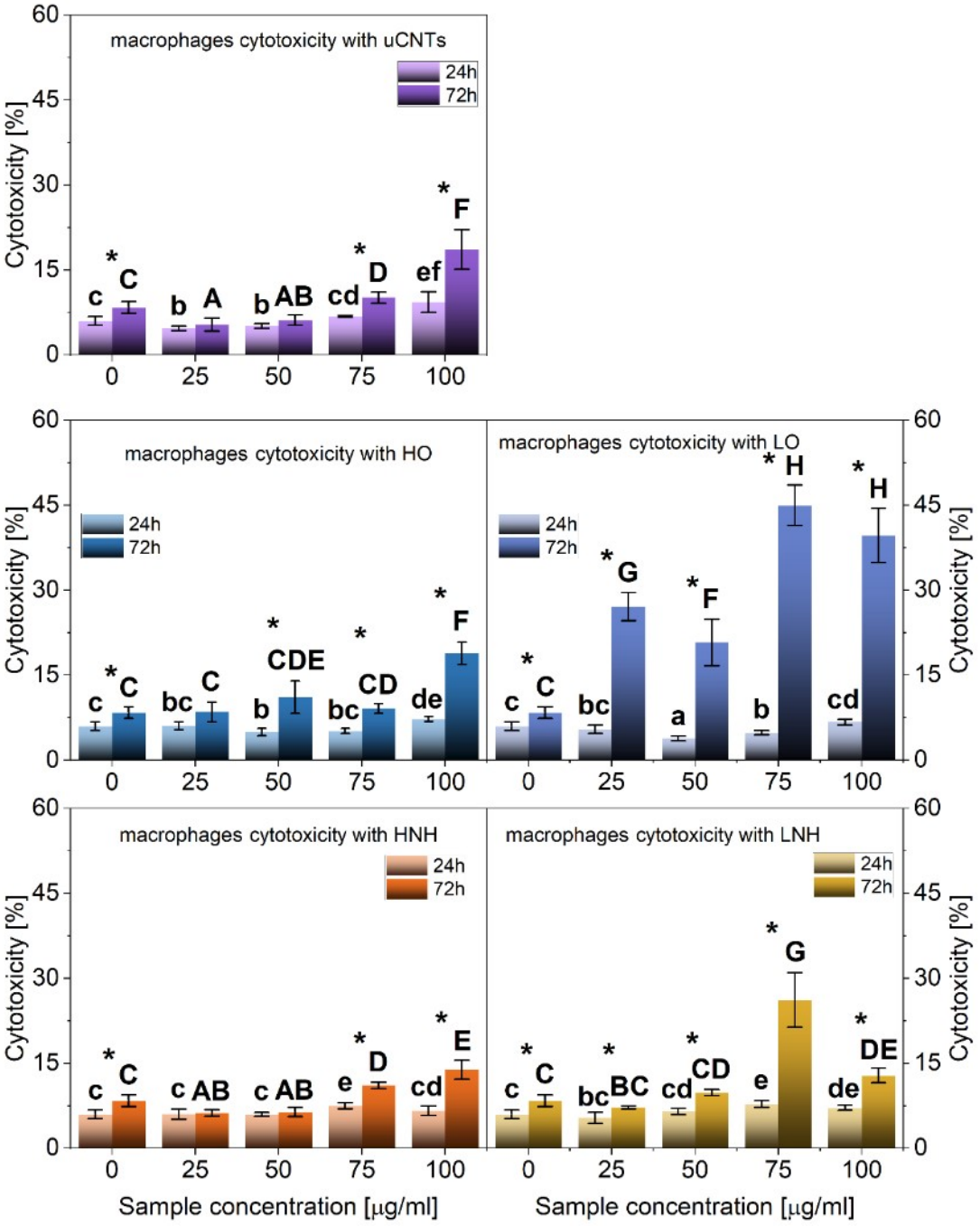

*SM 3 Averaged DTG plots of 3 separate measurements conducted on different CNTs types, presented along with the standard deviation values.*

*SM Table 1 Residual masses of the CNTs, left after heating the samples in an inert atmosphere and to a certain temperature, combined with the as-calculated percentages of functional groups, assuming that the total mass lost up to 900 °C (100% comes from different functional groups)*

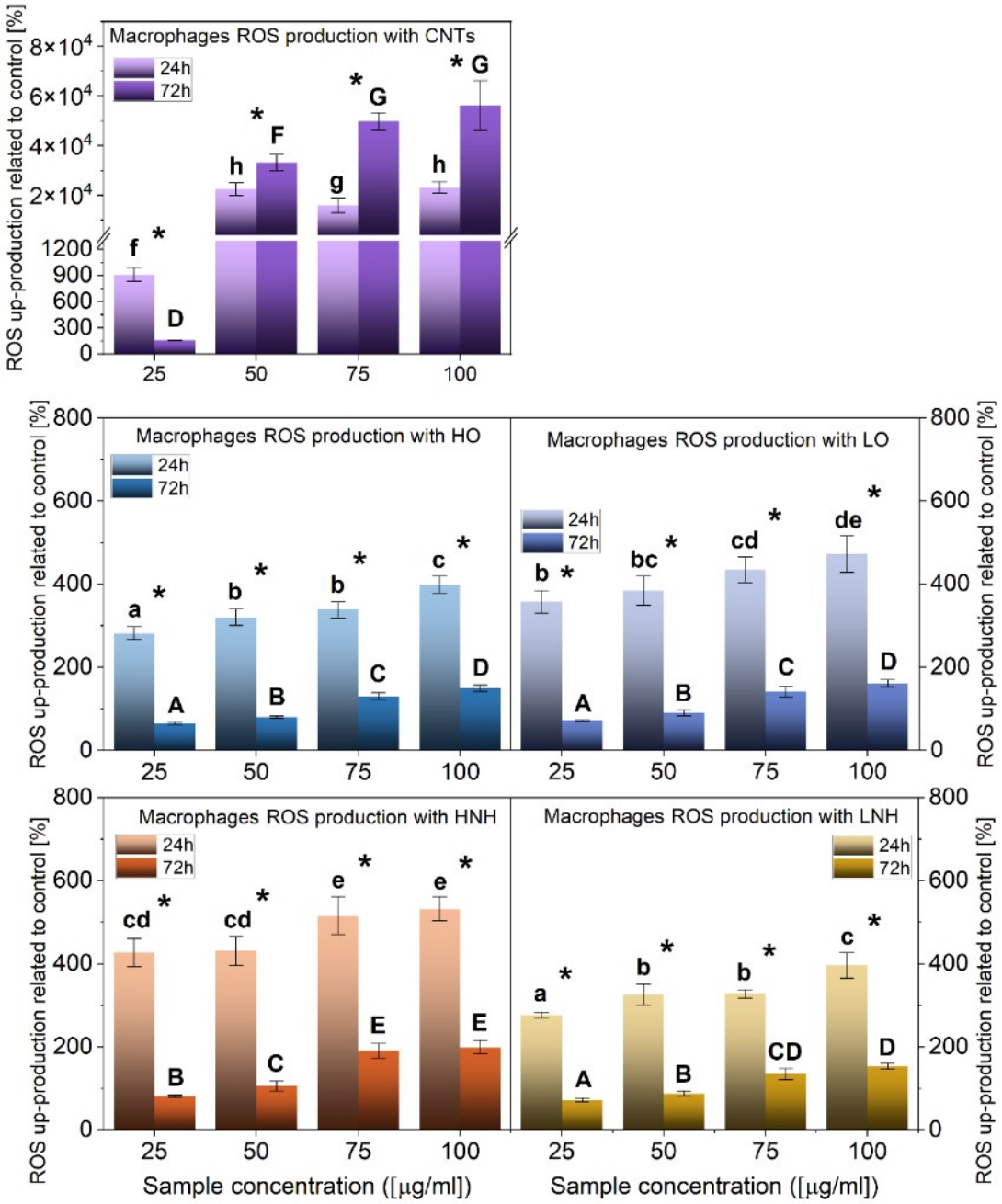
| | | **uCNTs** | **HO** | **LO** | **HNH** | **LNH** |
|---|---|---|---|---|---|---|
| Residual mass at 1200 °C [%] | | **96.5±1.1** | **83.7±0.7** | **87.9±2.3** | **81.0±2.5** | **84.4±0.0** |
| Residual mass at 900 °C [%] | | 98.2±0.6 | 85.5±1.0 | 89.5±2.3 | 86.3±1.2 | 87.4±0.4 |
| The total amount of carbon atoms at 900 °C ($TA_C$) [%] | | 97.6±0.8 | 81.2±1.2 | 86.2±2.8 | 81.6±1.7 | 83.4±0.5 |
| The total amount of oxygen atoms at 900 °C ($TA_O$) [%] | | 2.4±0.8 | 18.8±1.2 | 13.7±2.8 | 15.5±1.5 | 9.5±6.7 |
| The total amount of nitrogen atoms at 900 °C ($TA_N$) [%] | | 0 | 0 | 0 | 2.9±0.3 | 1.6±1.1 |
| relative content [%] | 40 – 150 °C hydrogen, physisorbed water | 4.5±7.9 | 6.4±4.4 | 7.1±5.4 | 5.2±4.8 | 5.3±0.2 |
| | 150 – 253 °C carboxyl, DCU | 3.1±5.4 | 18.5±0.4 | 17.1±1.5 | 20.4±2.0 | 23.5±1.2 |
| | 253 – 315 °C lactone at zig-zag edges, DCU residues | 5.1±1.8 | 9.7±0.7 | 10.3±0.8 | 9.2±2.6 | 15.7±0.4 |
| | 315 – 510 °C anhydrides, esters | 15.0±6.2 | 28.3±2.2 | 27.2±1.9 | 39.5±5.3 | 36.2±1.8 |
| | 510 – 620 °C lactone at armchair edges | 38.4±20.3 | 16.9±.1.6 | 16.7±1.9 | 13.2±0.6 | 12.8±0.9 |
| | 620 – 800 °C phenol, ether, stable derivative of anhydrides | 7.8±16.5 | 15.2±1.6 | 16.2±4.3 | 7.4±2.1 | 1.9±0.8 |
| | 800 – 900 °C carbonyl | 0.6±0.1 | 4.9±0.5 | 5.5±0.6 | 5.1±0.9 | 4.8±3.7 |



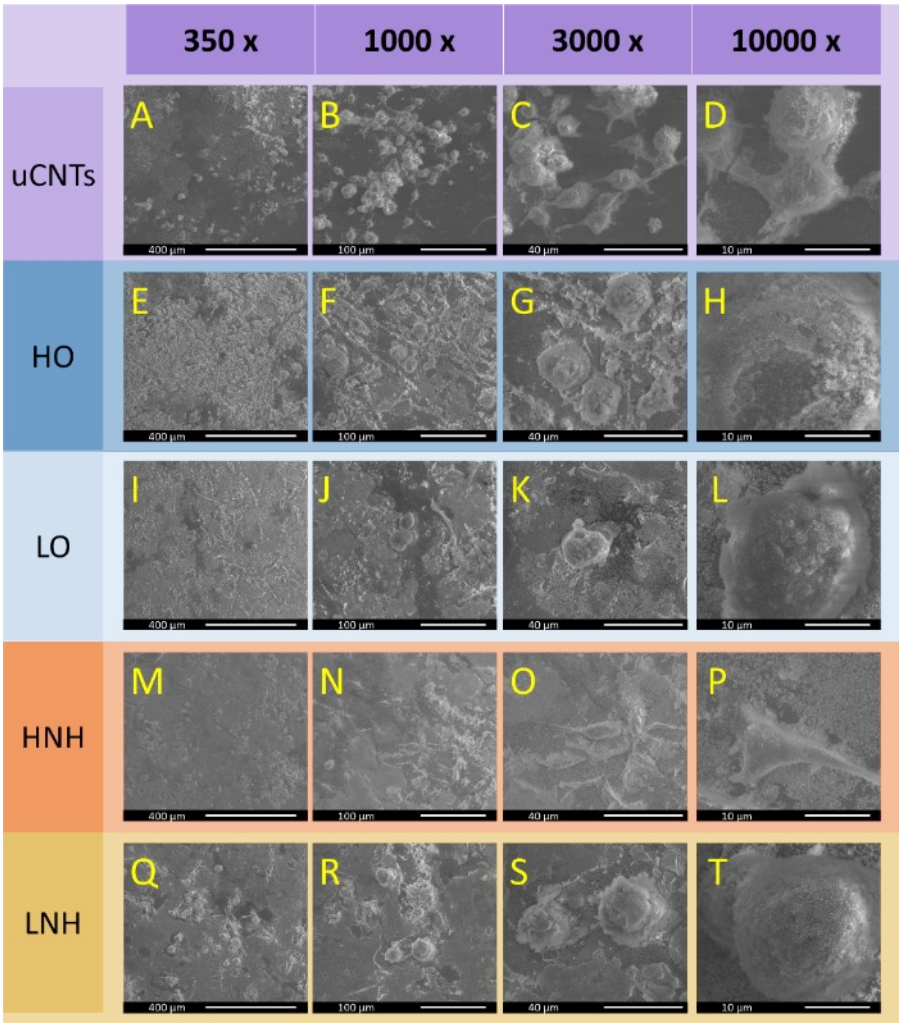

*SM 4 Proliferation of RAW 264.7 murine macrophages cultured with CNTs, tested via the ToxiLight assay. The data are presented as mean ± SD. Statistically significant differences ($p < 0.05$) between the tested materials compared to one another are marked a–g for the 1st day of culture and A–K for the 3rd day of culture; * indicates statistically significant differences between day 1 and day 3 of culture.*



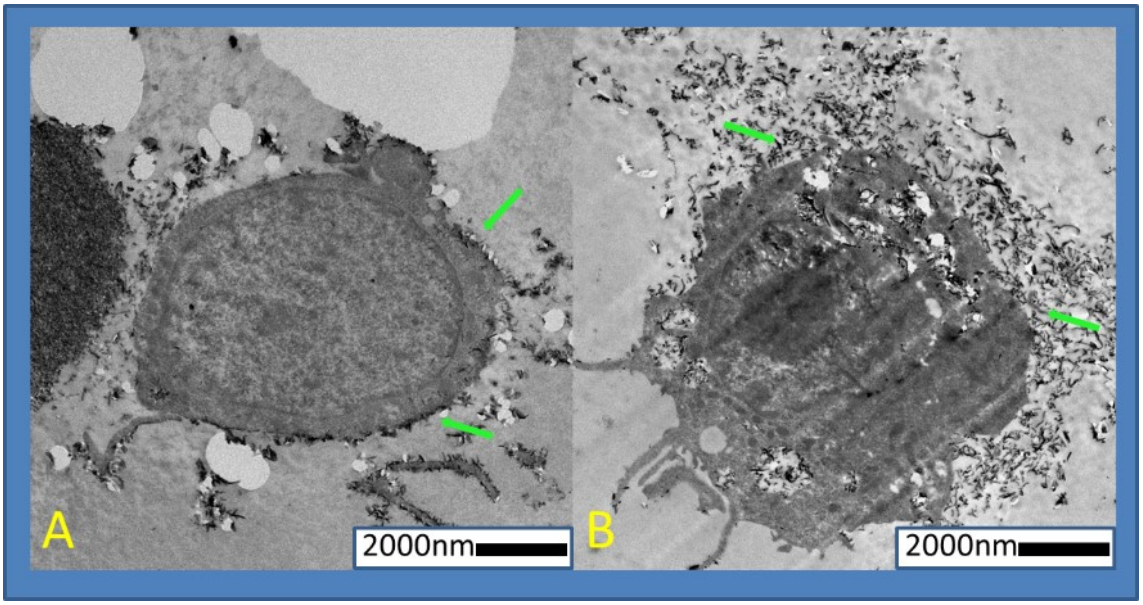

*SM 5 RAW 264.7 murine macrophage cytotoxicity against CNTs, tested via a ToxiLight assay. The data are presented as mean ± SD. Statistically significant differences ($p < 0.05$) between the tested materials compared to one another are marked a–g for the 1st day of culture and A–K for the 3rd day of culture; * indicates statistically significant differences between day 1 and day 3 of culture.*



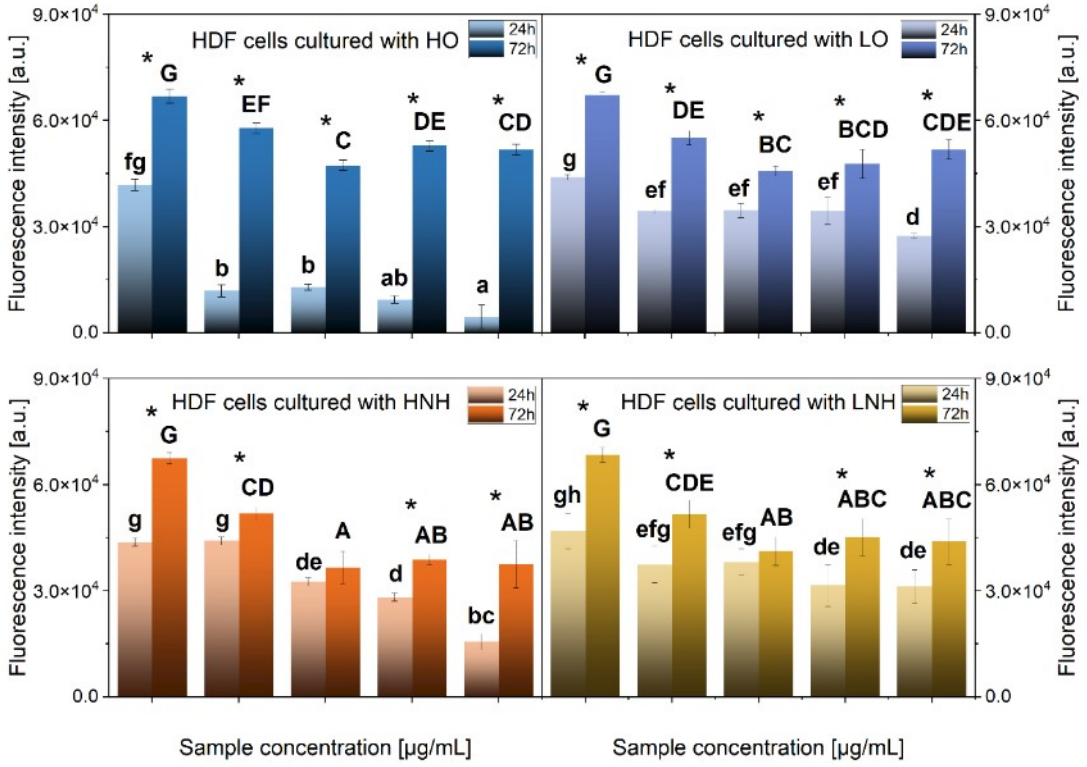

*SM 6 ROS production in RAW 264.7 macrophages cultured with CNTs, evaluated via DCFH-DA. The data are presented as mean ± SD. Statistically significant differences ($p < 0.05$) between the tested materials compared to one another are marked a–g for the 1st day of culture and A–K for the 3rd day of culture; * indicates statistically significant differences between day 1 and day 3 of culture.*



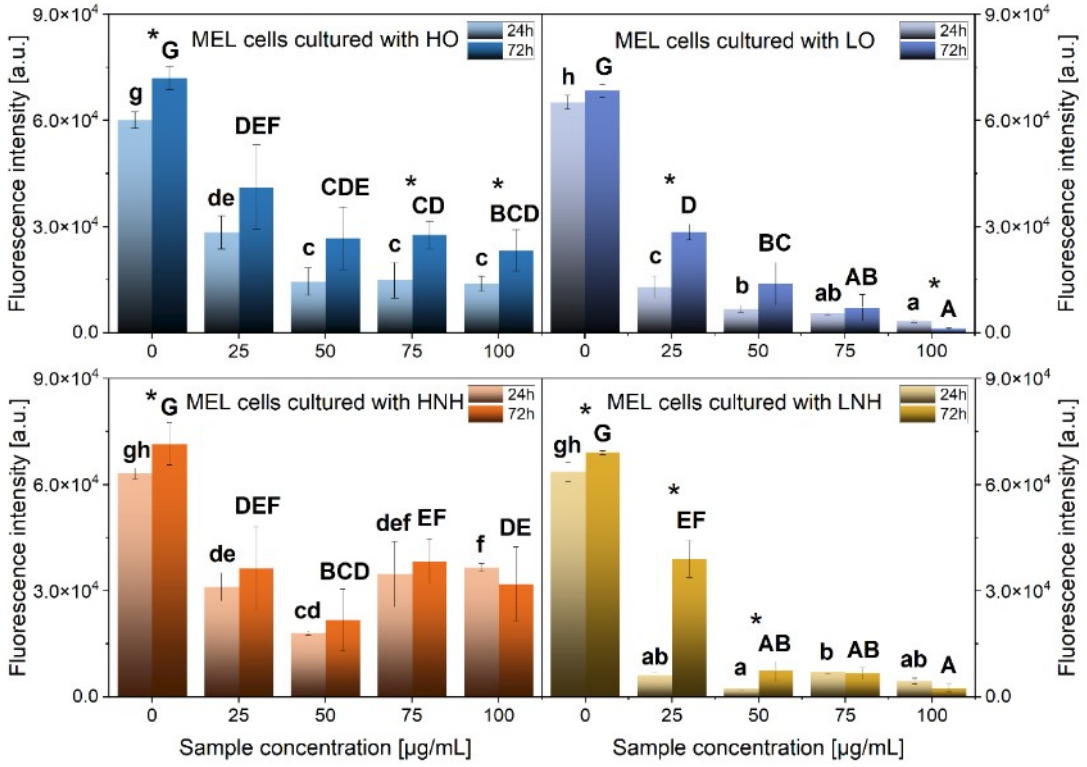

*SM 7 Scanning electron images of the macrophage cells and their morphological changes at the end of day 7 of culture with CNTs at a 100$\mu$g/ml concentration.*



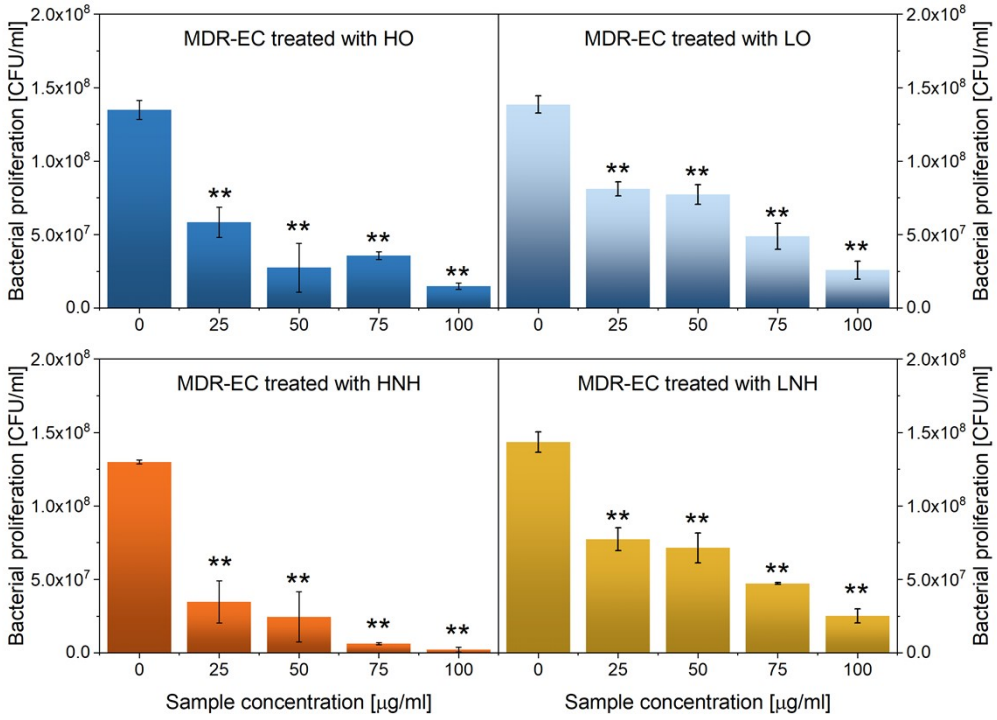

*SM 8. Transmission electron images of the macrophage cells and their interaction with carbon nanotubes. A) LO, B) –LNH. Green arrows indicate visible damage to the cellular membrane.*



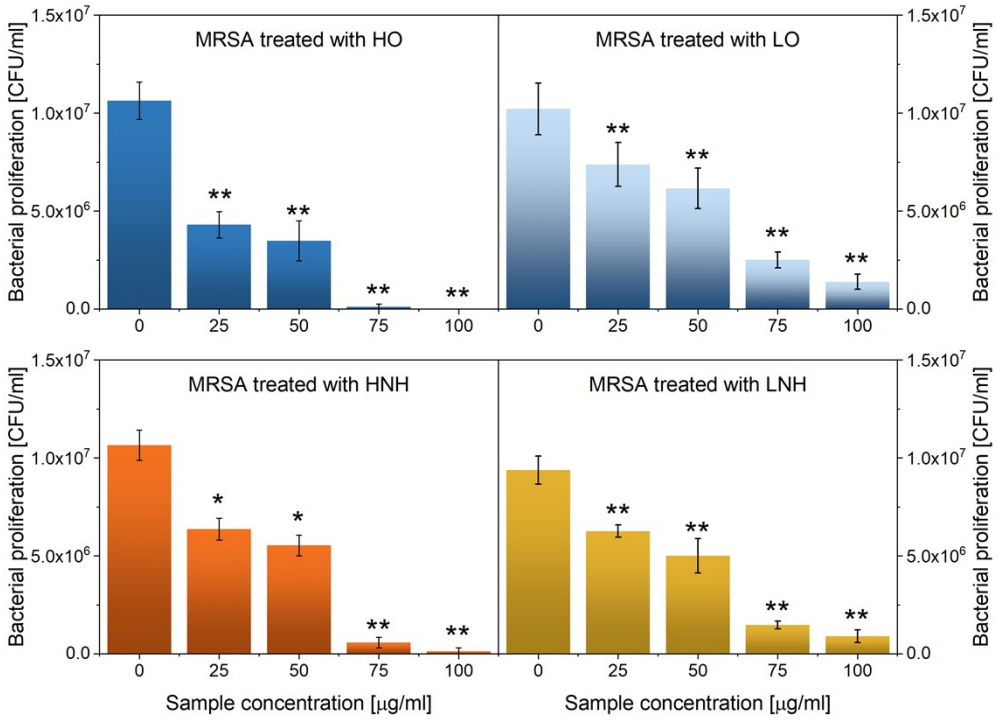

*SM 9 Proliferation of human dermal fibroblasts cultured with increasing concentrations of the modified CNTs. The data are presented as means ± SD. Statistically significant differences ($p < 0.05$) between the tested materials compared to one another are marked a–g for the 1st day of culture and A–K for the 3rd day of culture; * indicates statistically significant differences between day 1 and day 3 of culture.*




*SM 10 Proliferation of melanoma cells cultured with increasing concentrations of the modified CNTs. The data are presented as mean ± SD. Statistically significant differences ($p < 0.05$) between the tested materials compared to one another are marked a–g for the 1st day of culture and A–K for the 3rd day of culture; * indicates statistically significant differences between day 1 and day 3 of culture.*




*SM 11 Antimicrobial properties of CNTs against MDR-EC, as a function of increasing concentration. The data are presented as means ± SD. Statistically significant differences between the tested materials are marked * ($p < 0.05$) and ** ($p < 0.01$)*




*SM 12 Antimicrobial properties of CNTs against MRSA, as a function of increasing concentration. The data are presented as mean ± SD. Statistically significant differences between the tested materials are marked * ($p < 0.05$) and ** ($p < 0.01$)*