Optical control of cancer stemness with nanocarbon complexes

Strategies for eradicating cancer stem cells (CSCs) are urgently required, because CSCs are resistant to cancer drugs and cause treatment failure, relapse and metastasis. Here we show that photovactive functional nanocarbon complexes exhibit unique characteristics, such as homogeneous particle morphology, high water dispersibility, powerful photothermal conversion, rapid photoresponsivity and excellent photothermal stability. In this study, the present biologically permeable second near-infrared (NIR-II) light-induced nanocomplexes photo-trigger calcium influx into target cells overexpressing the receptor potential vanilloid family type 2 (TRPV2). This combination of nanomaterial design and genetic engineering effectively eliminate cancer cells and stemness of cancer cells in vitro and in vivo. Finally, in molecular analyses of mechanisms, we show that inhibition of cancer stemness involves calcium-mediated dysregulation of the Wnt/β-catenin signaling pathway. The present technological concept may inspire innovative cancer therapies in future.