CHRYSOTILE NANOTUBES FOR X-RAY ACTIVATED PHOTODYNAMIC THERAPY

I. Villa[1], C. Bonaldo[1], R. Crapanzano[1], M. Tawfilas[1], C. Villa[2], Y. Torrente[2], A. Vedda[1], M. Campione[3], A. Monguzzi[1]

[1]Dept. Materials Science, Università degli Studi Milano - Bicocca, Milano, Italy
[2]Dept. Pathophysiology and Transplantation, Università degli Studi di Milano, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico
[3]Dept. Earth and Environmental Sciences, Università degli Studi di Milano - Bicocca, Milano, Italy

Keywords: Photodynamic therapy; nanoscintillator, radioluminescence, singlet oxygen, cancer treatment
Corresponding Authors: Anna Vedda (anna.vedda@unimib.it)

Photodynamic therapy (PDT) is a minimally invasive potential therapeutic intervention for cancer, which has become a subject of interest in recent decades. PDT involves three components: light, oxygen, and a photosensitizer. When irradiated with light of a suitable wavelength, a photosensitizer absorbs the energy and generates reactive oxygenated species (ROS) or singlet oxygen (SO), responsible for the cell-killing and therapeutic effects. PDT, however, is ineffective for tumors located deep under the skin due to the short penetration depth in tissues of the visible light required by conventional photosensitizers. A potential solution to remove this drawback is the use of nanoscintillators. Upon x-rays excitation, the light generated by the nanoscintillators activates the photosensitizers through energy transfer to produce SO [1]. X-ray-activated PDT(X-PDT) therefore combines radio- and photo-dynamic therapies for a more efficient tumor destruction.

We present the results on hybrid fluorescent nanotubes working as X-PDT agents. An ionic self-assembly strategy is used to functionalize the surface of inorganic chrysotile scintillating nanotubes ($Mg_3Si_2O_5(OH)_4$) with efficient SO-sensitizer dyes, whose properties are preserved from *the in vitro* to the *in vivo* condition [2]. The occurrence of energy transfer from the chrysotile to different photosensitizers (Bengal Rose, Erythrosine B and porphyrin $TPPS_4$) has been verified, together with the subsequent production of $^1O_2$ under X-ray excitation. Finally, *in vitro* experiments are reported to verify the low cytotoxicity associated with the presence of functionalized nanotubes in the cellular environment. Therefore, chrysotile nanotubes can be considered as promising materials to be used as nanoscintillator for X-PDT.

[1] H. Chen et al. Nano Lett. 2015, 15, 2249
[2] C. Villa et. al. Adv. Funct. Mater. 2018, 1707582