Novel nanomaterials based on titanium composites conjugated with affibody molecules with potential photothermal conversion application

Cancer constitutes a constant health threat for the humankind. Therefore, the development of more effective, less invasive and without-adverse-effect treatment and diagnosis tools is necessary. Biocompatible nanomaterials, have appeared as a solution for both treatment and diagnosis. Among them, plasmonic and graphene-family nanostructures have been proposed. The first, owing to their localized surface plasmon resonance, are able to absorb light in the near-infrared (NIR) region while the second depict broad absorption toward the NIR spectra due to their aromatic lattice. Both groups of nanomaterials are able to convert NIR into heat. One of the light-based approaches utilizing nanomaterials is the photothermal therapy (PTT). PTT has emerged as an alternative to conventional treatments such as chemo- and radiotherapies because it allows to a localized and selective tumor ablation in the presence of nanosized photothermal conversion agents (PTAs). NanoPTAs are biocompatible, non-toxic nanomaterial, which are able to absorb near infrared (NIR) light and convert it into heat that increases the temperature of the tumor and causes the cell death, achieved because cancer cells are less tolerant to heat than the healthy cells. Despite the large number of nanoPTAs proposed, single nanomaterials do not achieve a maximum efficiency but the synergistic effect of different materials in nanocomposites is necessary. Moreover, target-ability as well as better suspension in physiological conditions (aqueous media) and improved cytotoxicity is required. Therefore, this project proposes the fabrication of novel nanohybrids based on Ti nanosheets (Ti NS) decorated with noble metal nanoparticles (NPs) and paired to reduced graphene oxide (rGO), which will yield nanocomposites to be functionalized with HER2-specific affibody molecules to provide the cancer-cell target ability, enhanced biocompatibility and dispersion in physiological conditions. The proposed project is the base for future breakthrough in the nanomaterial and nanomedicine research since the nanomaterials to be fabricated constitute future perspectives for not only cancer PTT but also for bacteria deactivation as well as combined cancer-therapies including photodynamic therapy (PDT), chemo and radio therapies as well as to the diagnosis in MRI, CT, and PA imaging.