# Gold nanoparticles decorated with POMs-Bisphosphonates for targeted treatment of bone cancers

This interdisciplinary project aims to develop an innovative multi-therapeutic platform for the treatment of bone metastases, which remain particularly difficult to manage due to poor bone vascularization and limited drug penetration. The strategy is based on the synthesis of anisotropic gold nanostars (AuNSs) functionalized with hybrid polyoxometalates (POMs) and bisphosphonates (BPs).

Gold nanostars constitute the central therapeutic core of the system. Owing to their plasmonic properties and strong absorption in the near-infrared (NIR) region, they enable efficient photothermal and photodynamic therapies upon irradiation, allowing spatially controlled tumor ablation. Their anisotropic morphology enhances electromagnetic field confinement, thereby amplifying photothermal conversion and plasmon-induced photochemical processes. When combined with polyoxometalates, these plasmonic effects further boost the generation of reactive oxygen species (ROS). POMs themselves exhibit intrinsic antitumor activity and act as redox-active catalysts, contributing to chemotherapy while reinforcing ROS-mediated cytotoxicity. In parallel, bisphosphonates ensure selective accumulation within bone tissue through their high affinity for hydroxyapatite and inhibit osteoclast-mediated bone resorption, thus limiting tumor-induced bone degradation.

A key innovation of the project lies in the fine modulation of the phototherapeutic response. By precisely adjusting irradiation parameters, it becomes possible to switch between high-temperature thermal ablation for efficient tumor destruction and mild photothermia (40–42°C). This moderate hyperthermia is designed not only to control tumor growth but also to stimulate osteogenic differentiation of skeletal stem cells, thereby promoting bone regeneration.

The nanoplatform is synthesized via a green, water-based approach and will undergo comprehensive in vitro evaluation on cancer cell lines and primary human cells, with the aim of establishing a versatile and translatable therapeutic strategy for complex bone pathologies.