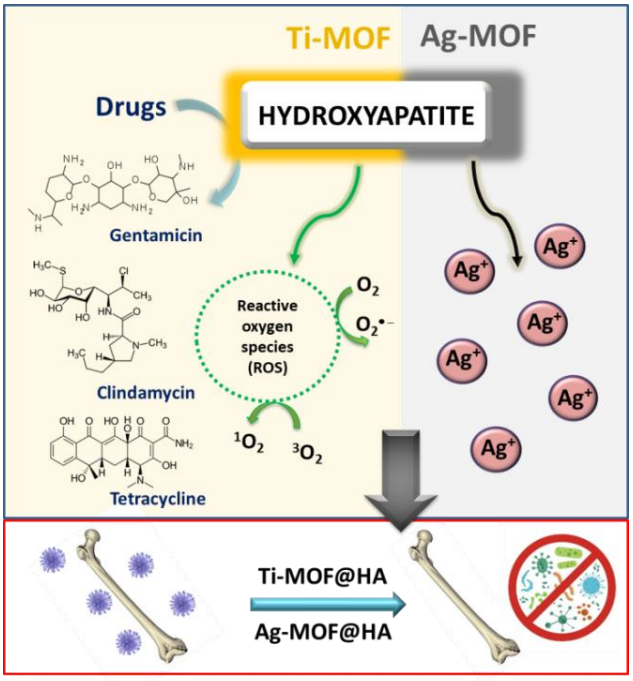
New functional MOF@hydroxyapatite composites for the treatment of bacterial bone infections

Bone infections mainly involve osteomyelitis associated with a graft or fracture. These problems have long been a challenge in orthopedics, as the infection can significantly affect the local tissue and regenerative capacity of the bone, hindering the healing of the defect.

Traditional treatment of such infections is multistep and can burden patients with long periods of antibiotic therapy. Therefore, the development of materials with dual antibacterial and regenerative functions in a single step would be a clinically important treatment strategy.



MOF@HA as novel composites with antibacterial properties.

To address the above issues, the project will produce novel composite materials containing **hydroxyapatite (HA)** nanoparticles coated with a **metal-organic framework (MOF)** layer of **titanium(IV)** or **silver(I)** with **antibacterial** and **regenerative** properties.

We expect that the reactive oxygen species **(ROS)** generated by Ti-MOF and the Ag^+ ions released from Ag-MOF will be responsible for the antibacterial properties of the **MOF@HA** materials. This effect will be enhanced by the controlled release of known antibacterial drugs, e.g., **gentamicin**, from the drug@Ti-MOF@HA system.

The regenerative effect of the new composites will be provided by synthetic hydroxyapatite, which is characterized by a high degree of osteointegration, biocompatibility, bioactivity, and lack of toxicity.

To confirm the research hypotheses, we will evaluate the antibacterial action of the composites against selected bacterial strains. Both the *in vitro* biocompatibility and the possibility of osteointegration after MOF@HA application will be determined. It is also planned to determine the nanomechanical properties in order to propose in which manner these materials can be administered to patients.

The realization of this project will enable the development and characterization of a new group of advanced materials with enhanced **biological activity** and **functionality**, thereby expanding the possibilities for biomaterial applications in the future. The development of such research may significantly contribute to a new approach to patients suffering from bacterial bone infections following implant treatment.