Bone tissue infections are now considered one of the most serious complications when attempting to **repair bone defects**. Orthopedic interventions related to graft implantations, tumors, and also open fractures due to trauma are associated with a high risk of bone infection, i.e. osteomyelitis, which is caused by the colonization of bacterial pathogens in the wound. Severe bone damage is also caused by tumor resection. Unfortunately, surgical resection is often unable to completely eradicate micro-metastases, which can result in postoperative recurrence and metastasis.

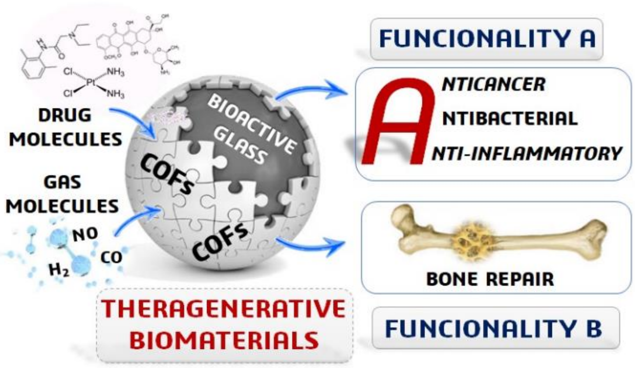
A real milestone in the development of new methods for bone **tissue regeneration** was the discovery of **bioactive glass (BG)**, a biomaterial that can easily bond to living tissue and is able to regenerate it. When the glass degrades, it releases sodium ions, calcium ions, and soluble silica - a process that stimulates osteoprogenitor cells and facilitates the production of new bone. On the other hand, despite all these advantages, BG is just a biomaterial that does not have the additional properties that today's therapies require.

Providing biomaterials with additional functionality beyond regeneration, i.e. the ability to have a therapeutic effect (**theragenerative material**) will represent a revolution in the development of biomaterials in the future and is the inspiration behind the research proposed in this project.

Taking into account the regenerative properties of BG and our previous experience in this field as the goal of the project, we aimed to design novel BG-based theragenerative materials. We plan to achieve the therapeutic properties of the biomaterial, i.e. *antitumor*, *antibacterial* or *anti-inflammatory*, by introducing suitable active compounds (A) into the pioneering **COF@BG** hybrid materials. **Covalent organic networks (COFs)** are characterized by good biocompatibility, and their inherent porous nature allows them to be host to guest molecules.

As guest molecules, or active compounds (A) in **A@COF@BG** systems, we propose:

- **drugs** with anticancer (cisplatin, doxorubicin), antibacterial (gentamicin) or anti-inflammatory (lidocaine) properties;
- **therapeutic gases** (H_2, CO, NO), providing A@COF@BG with the above-mentioned properties.



Strategy for obtaining theragenerative systems

The development of a matrix for the delivery of drugs or therapeutic gases with simultaneous regenerative ability is an **interdisciplinary** project, and so will the project team.

In addition to the synthesis of new A@COF@BG-type systems and their full structural spectroscopic and textural characterization, ***in vitro* toxicity** against normal cells will be determined. **Bioactivity** tests conducted in conditions simulating that of the human body will indicate the potential for bone tissue regeneration. In a further stage of research, the activity of A@COF@BG against selected **bacterial strains** or bone **cancer cells** will be determined, as well as its **anti-inflammatory** properties.

We believe that the implementation of the project will lead to the preparation and characterization of a very interesting group of advanced materials with new functionality, and as a result, the conduct of the planned research will improve human health in the future.