Kostas D Demadis et al., J Pharm Drug Deliv Res 2018, Volume 7
DOI: 10.4172/2325-9604-C1-026

Self-sacrificial metal-organic hybrid materials for controlled release of bisphosphonate osteoporosis drugs

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Osteoporosis is among the well-known bone diseases (other are osteoarthritis, multiple myeloma, Paget's disease etc.), which burdens millions of people compromising patients' quality of life. The recommended pharmaceutical treatment is the use of bis-phosphonates (BPs, a.k.a. "-dronates"). Their success in mitigating osteoporosis, notwithstanding these "-dronate" drugs present a number of challenges including fast excretion, and numerous side-effects, such as osteonecrosis of the jaw, hypocalcemia, esophageal cancer, ocular inflammation, atrial fibrillation, etc. Nevertheless, the main drawback of BPs is their limited oral bioavailability. It is, therefore, imperative to design and fabricate "smart" systems that allow controlled delivery of the active BP agent, which will depend on the patient's needs and idiosyncrasies. In this presentation, we discuss drug delivery systems that are based on metal–organic frameworks (MOFs). MOFs are well defined crystalline materials that possess an "inorganic" part (the inorganic metal ion) and an "organic" part, a molecule that can form coordinating bonds with the metal ion. In these materials, we have used biologically acceptable inorganic metal ions (eg. Ca^{2+}) and bisphosphonates as the organic portion. These materials have been synthesized, characterized, and studied for the self-sacrificial release (by pH-driven dissolution) of the bisphosphonate active ingredient. Several such materials were prepared with a variety of bisphosphonate drugs. They exhibit variable release rates and final % release, depending on the actual structure of the metal-bisphosphonate material.

Biography

Kostas D Demadis is a Full Professor in the Department of Chemistry, University of Crete, Greece and Head of the Crystal Engineering, Growth & Design Laboratory. His research group is interested in a number of research areas such as coordination polymers with emphasis on metal phosphonate MOFs, functional polymers, silicon chemistry (modeling of biosilicification mechanisms), water treatment issues (mineral scale inhibition, corrosion control, metal ion absorption), controlled release of active ingredients (in particular bisphosphonate drugs), "green" chemistry, and hybrid polymeric materials for cultural heritage protection. He has published ~150 papers in peer reviewed journals, about a dozen chapters in books, four books, and is the inventor of two patents...

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