

Brief information about the project

Name of the project	“Synthesis of magnetic and fluorescent iron-containing “heavy-metal-free” quantum dots”
Relevance	Research on binary QDs (e.g., HgS, PbS, CdSe) has been active in recent decades due to their high fluorescence, size-dependent optical and electronic properties, and simple synthesis methods. However, the presence of heavy metals such as Cd, Pb, Hg in their composition makes them unsuitable for biomedical or clinical use. Subsequent studies carried out to improve their quantum yield and reduce toxicity led to the development of ternary and quaternary QDs that do not contain heavy metals, such as AgInS ₂ , CuInS ₂ , CuInGaSe ₂ , AgInS ₂ /ZnS ₂ . Among these nanocrystals, AgInS ₂ QDs have a wider band gap range, which allows the color of their emission to be controlled. Typically, the emission wavelength of triple QDs can be selected by controlling their sizes. In the case of QDs such as AgInS ₂ QDs, such emission tuning can also be achieved by changing the Ag/In/S ratio or by attaching higher bandgap ZnS which is used as the shell.
Purpose	Adding of Fe atoms to AIZS or AIGZS nanocrystals by doping or by preparing Fe ₃ O ₄ nanoparticles with QDs will result in fluorescent and magnetic properties in the target nanocrystals, which will be of great interest in the development of probes for bimodal imaging or therapeutics.
Objectives	Objective 1. Synthesis of ferro- or paramagnetic Fe-doped AIZS or AIGZS QDs by thermal decomposition in the presence of a capping ligand and their characterization. Objective 2. Synthesis of Fe ₃ O ₄ /AIZS or Fe ₃ O ₄ /AIGZS core/shell nanocrystals and study of their optical and magnetic properties. Objective 3. Transfer into the aqueous phase from organic media prepared by QD using appropriate ligands.
Expected and achieved results	1. Highly fluorescent nanocrystals based on Ag-In-Zn-S (AIZS) or Ag-In-Ga-Zn-S (AIGZS) will be obtained by doping with Fe ions or by obtaining Fe ₃ O ₄ /AIZS(AIGZS) core/shell structures; 2. The fluorescent and magnetic properties of nanocrystals based on Ag-In-Zn-S (AIZS) or Ag-In-Ga-Zn-S (AIGZS) will be determined.
Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles	Galieva Perizat Asylbekkyzy ORCID: https://orcid.org/0000-0002-7085-4330 Scopus Author ID: 57140593200 ResearcherID: AFK-8152-2022
List of publications with links to them	Perizat Galiyeva, Henri-Pierre Lasalle, Bolat Uralbekov, Raphaël Schneider. Fluorescent and magnetic Mn-Gd or Fe-doped Ag-In-Zn-S QDs : Aqueous synthesis and characterization. 9th Nanotech & Nanomaterials Research Conference, Nano Rome 2023, Jun 2023, Rome, Italy. (hal-04144102) https://hal.univ-lorraine.fr/hal-04144102v1
Patents	-