Helical systems commonly found in nature (DNA, proteins) have become an inspiration for scientists, not only because of their spectacular appearance, but above all thanks to the enormous application potential, which results from the fact that they have a chance to exhibit chirality. For future optoelectronic and metamaterial technologies, chiral helicoid systems based on anisotropic, metallic nanoparticles, which ensure strong interactions of an electromagnetic wave (in the visible range) with a given material, are of particular interest. One of the greatest challenges of contemporary material chemistry is to obtain helicoidal materials with precisely and dynamically controlled structural parameters, which consequently determine the properties. The problem is that current methods result in the formation of static structures, with a limited optical plasmon chiral response.

Within the frames of the project outlined here, I propose to achieve materials with enhanced chiral plalsmon properties and dynamically controlled structure. The method planned is based on doping of gold / silver / their alloy / core-shell nanorods stabilized with promesogenic ligands using liquid crystals: cholesterics, nematics supplemented with chiral compounds and nematic twist bend (NTB) compounds. The second approach will be to selectively introduce ligands (LC / peptides) onto the surface of the nanoparticles. The use of such approaches makes it possible to: (i) obtain enhanced chirality in the visible range due to the helicoidal arrangement of nanoparticles, and (ii) control the optical chirality of the material by means of temperature or electric field.

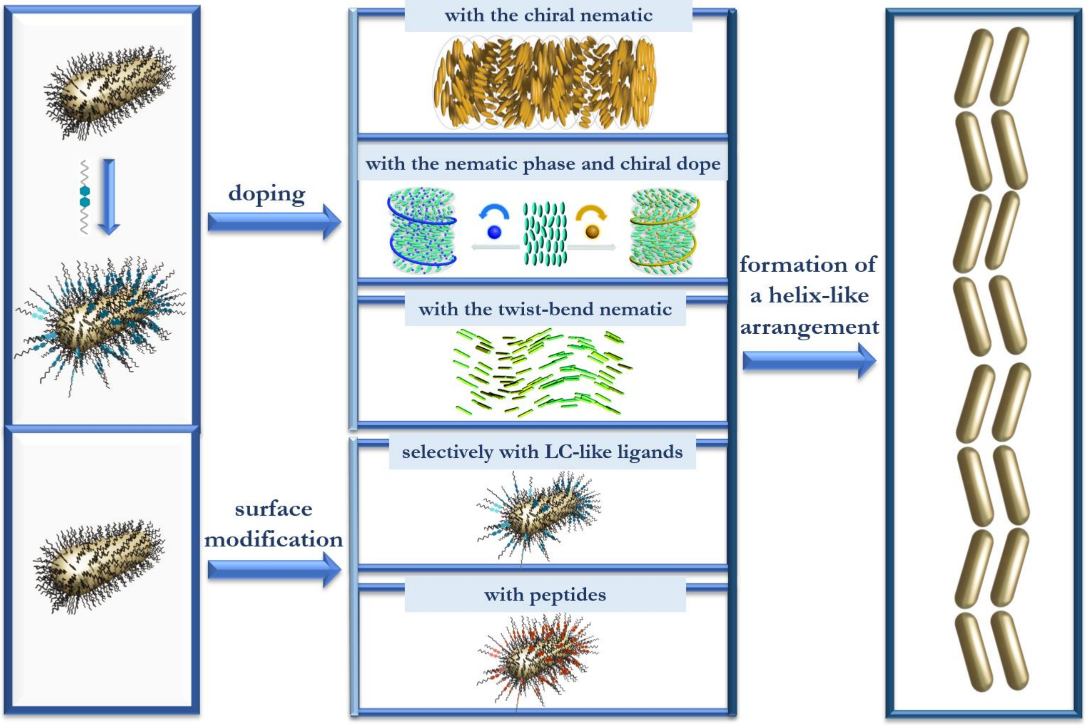

Fig. 1 Diagram showing the main objectives of the proposed project: complete or partial modification of nanorods surface with ligands or peptides of the LC type and doping them with liquid crystalline compounds in order to obtain a helicoidal nanorod system

As part of the project, I will synthesize four types of plasmonic anisotropic nanoparticles with a core made of gold, silver, their alloy and core-shell nanoparticles. Then I will modify their surface with promesogenic ligands. The liquid crystal nanoparticles prepared in this way and chemically compatible dopants will be used to optimize the method of obtaining helicoidal systems. Structural and functional parameters will be determined through a number of analytical techniques, such as transmission and scanning electron microscopy, atomic force microscopy, low angle X-ray diffraction, and UV-Vis spectroscopy and circular dichroism.

In summary, the optically active, dynamically switchable materials with a helicoid structure obtained in this project constitute a completely new class of structures that are the hope for the development of technologies based on plasmon chirality (chiral metamaterials, sensors, spinotronics and many others).