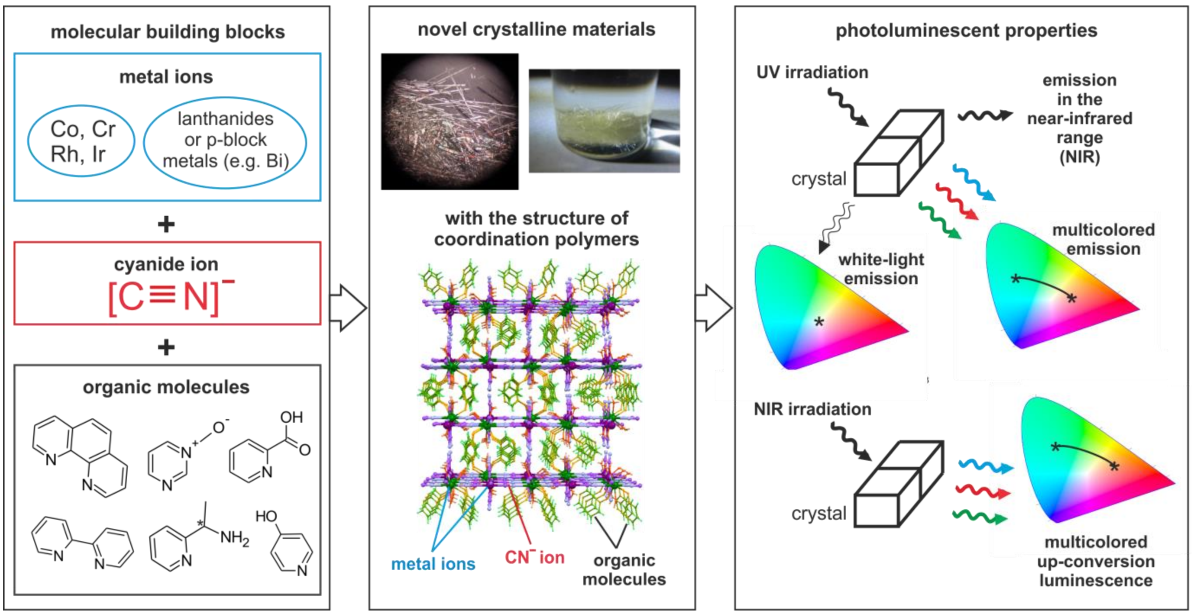
DESCRIPTION FOR THE GENERAL PUBLIC

Luminescent materials are defined as the materials revealing light emission cause by external stimuli. There are several types of luminescence differing in the source of light generation. For instance, photoluminescence is induced by the absorption of photons, which means that the application of light with one specific wavelength, e.g. UV, leads the emission of light with the another wavelength, e.g. green light. Electroluminescence is induced by an electric current, chemiluminescence is related to the chemical reaction while mechanoluminescence is a result of a mechanical action on a solid. Within the many types of luminescence, the leading role is played by photo- and electroluminescence, and the materials showing these effects find numerous applications. In our project, we focus on the photoluminescent materials.

Luminescent materials are broadly applied in science, technology, and our everyday life. They are applied in cathode ray tubes, fluorescent tubes, light-emitting diodes (LED), amplifiers in optical communication, and optical memories. They start to arouse the scientific interest also due to their applications in such fields as energy conversion, sensing of chemicals, photovoltaic devices, and bioimaging. The great attention is especially paid to the usage of luminescent materials in light-emitting devices and displays. In this context, there are four (a-d) important luminescent properties: (a) white-light emission needed in displays and lighting, (b) multicolored emission for the construction of light-emitting devices, with the additional tunability of the emission color by external stimuli enabling the applications in luminescent thermometers and chemical sensing, and (c) emission in the near-infrared (NIR) range for the applications in optical communication. In the case of photoluminescent materials, all these optical phenomena are usually induced by strong UV light which makes problem in the photostability of the materials under prolonged excitation. Thus, the another desired property (d) is the visible emission induced by safer and cheaper sources of light operating in the NIR range, which is achievable in the so called up-conversion luminescence.

The aim of the project is to synthesize and investigate novel crystalline materials exhibiting these for above mentioned (a-d) photoluminescent functionalities (Scheme 1). To achieve this, we plan to employ so called coordination polymers which are the compounds built of metal ions combined with organic and inorganic molecules within the solid phase (crystal). We will apply the synthetic molecular building block approach where coordination polymers can be rationally design and prepare by the selected combination of building blocks: metal ions, organic and inorganic molecules. In our project, we plan to employ transition metal ions of chromium, cobalt, rhodium, and iridium, combined through cyanide ions with other metal ions of lanthanides (e.g. europium and terbium) and p-block metals (e.g. bismuth), with the additional contribution of small organic molecules based on aromatic rings. Our preliminary results and literature review indicated that the coordination polymers constructed of such specific building blocks will a good basis for the synthesis of novel crystalline materials exhibiting strong photoluminescent properties. The project is aimed at the pioneering application of the above mentioned transition metal ions (chromium, cobalt, rhodium, iridium) bounded to cyanide ions in construction of crystalline materials showing a variety of emission light phenomena. We plan to show them as the promising alternative to traditional inorganic and organic solids for the construction of light-emitting devices which can find vital applications in future technologies affecting our everyday life.



Scheme 1. Graphical presentation of scientific goals and concept of the project.