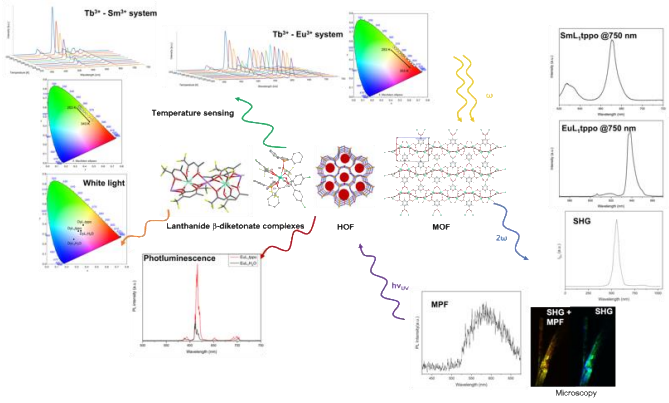
Luminiscentni lantanoidni materijali za primenu u fotonici

Dr. Dimitrije Mara

Institute of General and Physical Chemistry, Studentski trg 12/V, 11158 Beograd, Srbija, P.O. Box 45, Srbija

Luminiscentni lantanoidni materijali se nalaze u upotrebi od poslednje decenije 19. veka kada je austrijski naučnik Karl Auer fon Velsbah patentirao svetlosni omotač nazvan Auerov omotač za Auerovu svetlost. [1] Od tog vremena do dana današnjeg, luminescenti lantanoidni materijali su našli primenu u različitim poljima fotonike od lasera, osvetljenja, telekomunikacije, senzora do primene u kvantnim tehnologijama. [2] Luminiscentni lantanoidni materijali se mogu podeliti u dve vrste materijal koja zavisi sredine u kojoj se joni lantanoida naći: 1. molekularni materijali i 2. neorganski materijali.

Molekularni luminiscentni lantanoidni materijali daju širi opseg upotrebe zbog njihove fleksibilnosti u odnosu na luminiscentne lantanoidne materijala na neorganskoj osnovi, jer postoji mogućnost dizajna specifičnog materijala za specifičnu primenu koju hoće da se koristi. Takođe, moguće je uvesti ih u različite složene matrikse (kao što su sol-gelovi, polimeri) ili ih staviti na struktuirane površine kao što su optičke šupljine ili plazmonske strukture.



Linearni i nelinearni optički odgovor i njihova primena.

Neorganski luminiscentni lantanoidni materijali su zbog svojih karakteristika u odnosu na molekularne materijala kao što su kompleksi imaju ulogu domaćina jona lantanoida i distribucija ovih jona nije jednaka. Zbog nemogućnosti kontrole distribucije jona lantanoida u slučaju kada se koristi veća koncentracija ovih jona dovodi do kvenčovanja luminiscencije. Primenom različitih vrsta sinteza moguće je dobiti različite tipove materijala fosforne materijale, polioksometalata i neorganskih nanočestica. Primena je ograničena zbog manje fleksibilnosti materijala za eksitaciju i potencijalne toksičnosti.

U ovom predavanju biće predstavljeni različiti tipovi molekularnih i neorganskih luminiscentnih lantanoidnih materijala kao što su kompleksi, vodonično vezani organski okviri (HOFs), metaloorganski okviri (MOFs), fosforni, perovskite, polioksometali materijali. Neki od primera primene koji će biti predstavljeni su senzori kroz primer optičkih termometara, telekomunikaciju i materijali sa nelinearnim optičkim svojstvima kao što su generacija drugo harmonika (SHG) i multifotonske fluorescencije (MPF) koji mogu da nađu primenu u kvantnoj optici, kvantnoj telekomunikaciji i kvantnim računatima.

Reference:

[1] J.-C. G. Bunzli, I. Mcgill, Rare Earth Elements, Ullmann's Encyclopedia of Industrial Chemistry, American Cancer Society (2018), pp. 1-53.

[2] J.-C. G. Bunzli, Lanthanide Luminescence: From a Mystery to Rationalization, Understanding and Applications, Handbook of the Physics and Chemistry of Rare Earths, Chapter 287, Vol. 50 (2016), pp. 141-176.

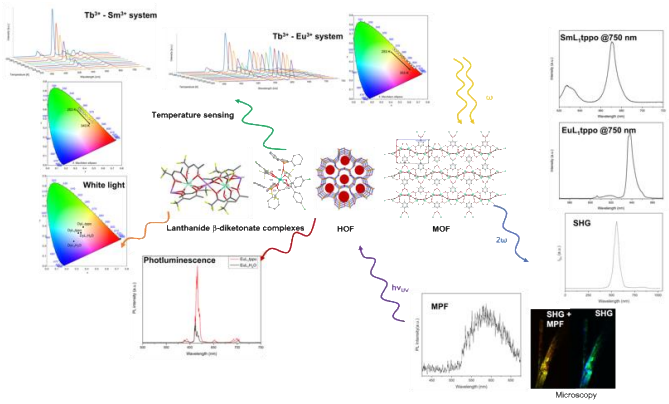
Luminescent lanthanide materials for photonics applications

Dr. Dimitrije Mara

Institute of General and Physical Chemistry, Studentski trg 12/V, 11158 Beograd, Srbija, P.O. Box 45, Srbija

Luminescent lanthanide materials have been in use from the last decade of 19th century when the Austrian scientist Carl Auer von Welsbach has patented the light mantle called Auer mantle of Auer light.[1] From that time till know the luminescent lanthanide materials have found application in different fields of photonics from lasers, lighting, telecommunications, sensors to quantum applications.[2] Luminescent lanthanide materials can be divided in two groups of materials based on the environment in which lanthanide ions can be found: 1. molecular materials and 2. inorganic materials.

Molecular luminescent lanthanide materials give wider range of the flexibility in use from the inorganic based luminescent lanthanide materials, as there is possibility of design of specific material for the application which it will be used for. Also, it is possible to introduce it into different more complex matrixes (such as sol-gels, polymers) or put them on the structured surfaces such as cavities or plasmonic structures.



Linear and nonlinear optical response and applications

Inorganic luminescent lanthanide materials because of its characteristics compared to the molecular materials such as complexes have the role of the host for the lanthanide ions and their distribution is not even. Due to the difficulty to control the distribution of lanthanide ions in case of higher concentration of these ions can lead to quenching of luminescence. Using different type of synthesis it is possible obtain different type of materials such as phosphor materials, polyoxometalates and inorganic nanoparticles.

Here, it will be presented different types of molecular and inorganic luminescent lanthanide materials such as complexes, hydrogen bonded organic frameworks (HOFs), metalorganic frameworks (MOFs), phosphors, Perovskites, polyoxometalates. Some of the application which will be shown are on sensing in this case optical thermometry, telecommunications and on nonlinear optical properties such as second harmonic generation (SHG) and multiphoton fluorescence (MPF) materials which can have potential use in the quantum optics, telecommunications and computing.

Reference:

[1] J.-C. G. Bunzli, I. Mcgill, Rare Earth Elements, Ullmann's Encyclopedia of Industrial Chemistry, American Cancer Society (2018), pp. 1-53.

[2] J.-C. G. Bunzli, Lanthanide Luminescence: From a Mystery to Rationalization, Understanding and Applications, Handbook of the Physics and Chemistry of Rare Earths, Chapter 287, Vol. 50 (2016), pp. 141-176.