CeNT CENTRE OF NEW TECHNOLOGIES

UNIVERSITY OF WARSAW

invites to a seminar by

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Towards more efficient materials for nonlinear absorption and nonlinear refraction applications

27th April 2017 at 1:00 p.m.

Venue: Centre of New Technologies, Banacha 2C,
Lecture Hall 0142 (ground floor)

Host: Prof. Joanna Kargul

Over many years numerous research groups have been pursuing the quest for better third-order nonlinear optical (NLO) materials that would be useful for the emerging applications in laser technologies, telecommunication and biophotonics. While finding practical material solutions for low-power, high-speed all-optical switching has proved elusive to date, much success has been achieved in synthesizing high performance two-photon absorbing systems, including organic and organometallic dyes, polymers, dendrimers etc.
We have been exploring several pathways towards more complex systems where one could optimize both the nonlinear optical effect of interest and other functionalities of the system such as bright luminescence or biological function. One direction that proved particularly promising is that of nanoparticles of various kinds that can be engineered for particular functions, employing nanotechnological approaches, especially bottom-up wet chemistry approaches for syntheses of colloidal nanoparticles and ligand exchange. Indeed, nanoparticles made up of semiconductors (quantum dots), metals (plasmonic nanoparticles) and oxide or fluoride nanocrystals containing lanthanide ions have multiple advantages, e.g. as markers in nonlinear microscopy for biological use. However, there are also limitations of their use. We have demonstrated that several advantages of colloidal nanoparticles can be enhanced by their encapsulation or co-encapsulation with other active agents inside suitable nanocontainers that can then be treated as theranostic species because of the possibility of combining the therapeutic and diagnostic function in them.
Another interesting class of NLO materials is that of clusters that can be made either of metals or by combining metal atoms with other ones. As an example, gold clusters containing 25 Au atoms show efficient two-photon absorption as well as two-photon induced emission.
Recently there has been much interest in coordination polymers, especially so-called metal-organic frameworks (MOFs). We are currently studying several types of coordination polymers, e.g. we have found that nanoparticles of a well-known pigment, Prussian Blue, exhibit very strong nonlinear absorption. For several MOFs we have also seen both strong nonlinear absorption and efficient multiphoton-induced emission.