Project 4.8. Non-toxic quantum dots for solar energy harvesting (experimental)

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Background:

Quickly rising global energy consumption contributes to economical and environmental insecurity experienced worldwide. Energy production from light radiated from the sun is one of the solutions capable of meeting the long term increase in demand. However, the contribution of photovoltaic sources to present day energy production is still limited due to relatively high cost. It is therefore necessary to decrease the production costs of solar cells (SCs) and/or increase their efficiencies.

Aim:

The main source of losses in energy generation from the sun is the so called spectral mismatch: photons with energy much higher than absorber band gap are lost to heat and photons with lower energy are not absorbed at all. In this project, we will work to overcome the spectral mismatch by adapting the solar spectrum via energy conversion and transfer. To this end, we will design, fabricate, and engineer non-toxic quantum dots (QDs) based on group I-III-VI_2 compounds (e.g., $CuInS_2$). We will perform state of the art spectroscopic studies of these materials to understand energy relaxation pathways of electrons created by light absorption. The results of these studies will inform the design of target nanostructures, which will be employed in prototypical devices.

The successful candidate will take part in colloidal synthesis of the I-III-VI_2 QDs and will use the tools of ultrafast spectroscopy such as time-resolved photo-luminescence and transient absorption. These studies will be performed in the range of temperatures between 2 and 300 K and in magnetic fields up to 70 T via collaborations with the University of Warsaw, Poland and National High Magnetic Field Laboratory in Toulouse, France. She/he will join a young group of researchers working on various nanostructure systems with a view of applications ranging from optoelectronics to nanomedicine.

Requirements:

Master's degree (or equivalent) in physics, chemistry, or related field
Experience with optical spectroscopy
Experience with data analysis tools
Proficiency in English
Excellent team work

Funding:

Scholarship: grant funding of 4000 PLN per month, before subtracting obligatory employer and employee social security contributions (~15%) for 36 months. Afterwards, standard Polish PhD scholarship about 3240 PLN/month net (or more conditional on grant applications).

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