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ОТЗЫВ

члена диссертационного совета на диссертацию Кононова Алексея Игоревича на тему «Электронно-возбужденные состояния ДНК и комплексов ДНК с нанокластерами серебра», представленную на соискание ученой степени доктора физико-математических наук по специальности 01.04.07 — Физика конденсированного состояния.

In the following I would like to give my statement concerning the qualifications of the following thesis for the degree of Doctor of Physical and Mathematical Sciences: “Electron-excited states of DNA and DNA complexes with silver nanoclusters”.

In this thesis Alexey Kononov investigates comprehensively the electronic structure of the complexes consisting of DNA and Ag clusters with the generic goal of understanding how solar radiation alters DNA structure. Theoretically and experimentally it is shown that silver nanoclusters could be considered as effective acceptors of excitation energy in complexes with DNA. In this respect a structural model of hot spots of photochemical DNA damage under irradiation is proposed, which serves as a foundation of the developing of photo-protectors reducing the risk of oncogenic diseases. The main effort is put on investigation of silver nanoclusters as potential desensitizers of the negative effects of UV radiation.

On the way to achieve his goals, he proposed also that the understanding of the photo-chemical processes in the DNA-Ag complexes can help for construction of chemical and bio-sensors, as well as development of UV light converters for effective photovoltaic cells. Special attention is paid for development of a technique for bio-imaging based on fluorescence saturation spectroscopy of luminescent silver clusters in heterogeneous solutions. Also an important and involved experimental study concerning ultrafast (femtosecond time scale) dynamics of electronic excitation in Ag clusters has been conducted.

The thesis starts by giving a comprehensive introduction and literature review of the different aspects of photo-physics of DNA as pure molecule as well as in the complexes with different dyes and metal clusters. The introduction is written very well and gives all details of the basics, but also the newly discovered phenomena in this area, needed for understanding of the Results Section. The Results Section summarizes the contents of 14 publications. Especially I like the study concerning the shape of DNA molecules stabilized by luminescent silver clusters. Here it is shown that the DNA has a duplex or hairpin like structure. Moreover, it is reported that efficient excitation transfer from DNA to a cluster (excitation acceptors) is possible in a region of ca. 30 nucleobases at a time scale $\lesssim 100$ fs. It is also described how the energy transfer mechanism takes place involving the delocalization of electronic excitation (coherent exciton) over 5 nucleobases in a single DNA strand. This piece of work represents novel high-quality science and will trigger further developments in the field of photonics. In the Conclusion Section an assessment of the scientific significance of the present and an outlook on future work is given.

As a summary I consider the overall quality of this thesis to be excellent and the candidate's own contribution is more than sufficient for meeting the criteria for a Doctor thesis both with respect to quality and quantity. The 14 publications presented in this thesis are published in high ranking international materials chemistry and physics journals such as JACS, Scientific Report, J Phys Chem B, Phys Chem Letter, Nucleic Acids Research, underlining the excellence of the results of this thesis.

Диссертация Кононова Алексея Игоревича на тему: «Электронно-возбужденные состояния ДНК и комплексов ДНК с нанокластерами серебра» соответствует основным требованиям, установленным Приказом от 01.09.2016 № 6821/1 «О порядке присуждения ученых степеней в Санкт-Петербургском государственном университете», соискатель Кононов Алексей Игоревич заслуживает присуждения ученой степени доктора физико-математических наук по специальности 01.04.07 — Физика конденсированного состояния. Пункт 11 указанного Порядка диссертантом не нарушен.

Potsdam, 26.08.2020



Prof. Dr. Svetlana Santer