iOQ JENA
Friedrich-Schiller-Universität

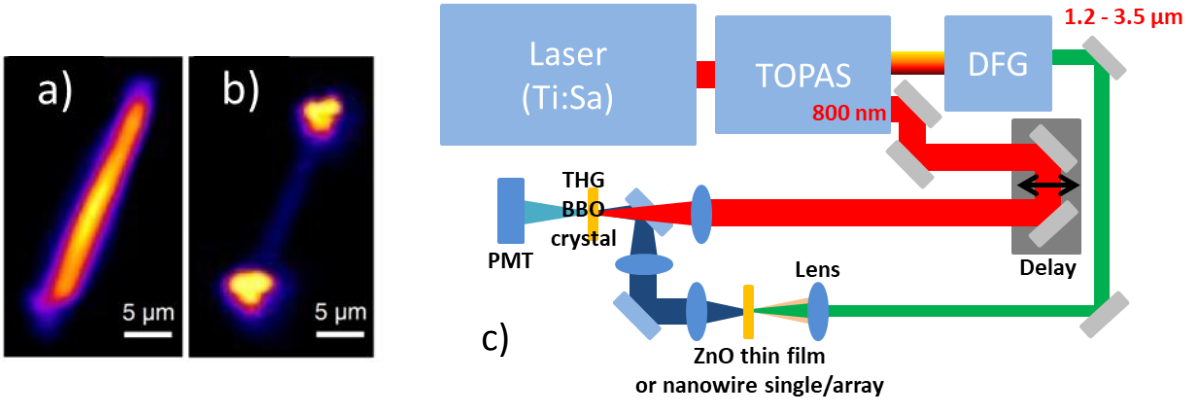
Internship or Bachelor / Master Thesis

Dynamics of multiphoton-pumped nanowire lasers

Zinc oxide (ZnO) nanowires have a diameter of a few hundreds of nm and a length of several µm. Nevertheless they fulfill all requirements for realizing a nanolaser: ZnO is a well studied gain medium, and the cylindrical geometry, together with the end facets, forms a waveguide cavity. So far mainly single photon pumped nanolasers have been investigated [1]. More recently, we demonstrated multiphoton absorption pumped ZnO nanolasers using intense femtosecond laser pulses in the wavelength range from the near (0.8µm) to the mid-IR (3.5µm). Under these excitation conditions up to 11 photons must be absorbed to excite the material, which is very unlikely. However, for high intensities we witness a transition from multiphoton absorption to tunnel ionization [2], for the first time.

To fully understand our recent observations, the temporal dynamics of the emission from single nanowires and nanowire arrays will be studied in the offered project. For this purpose a frequency up conversion technique must be realized [3]. The students work comprising the following tasks:

- Lab work: Set up experiment in our novel femtosecond laser lab.
- Implementation of all necessary lab software in LabView.
- Data acquisition and processing.



Emission profile of laser pumped nanowire a) below and b) above the lasing threshold. c) Up-conversion setup, to measure the temporal dynamic of the nanowire emission.

Literature:

[1] M. A. Zimmler, F. Capasso, S. Müller and C. Ronning, "Optically pumped nanowire lasers: invited review", Semiconductor Science and Technology, 25(2):024001 (2010).
[2] L. V. Keldash, "Ionization in the field of a strong electromagnetic wave", Soviet Physics JETP, 20:1307–1314 (1965).
[3] Jagdeep Shah, "Ultrafast Spectroscopy of Semiconductors and Semiconductor Nanostructures“, Springer Science & Business Media, Berlin Heidelberg

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