SECOND HARMONIC GENERATION AND IMAGING OF FUNCTIONALIZED CRYSTALLINE NANOAGGREGATES

Jonathan Brewer[1], *M. Schiek*[2], *A. Luetzen*[2], *K.Al-Shamery*[2] and *H.-G. Rubahn*[1]
1: Department of Physics and Chemistry and Mads Clausen Institute
University of Southern Denmark
DK- 5230 Odense M, Denmark
2: University of Oldenburg, Physical Chemistry I
D-26129 Oldenburg, Germany
Brewer@fysik.sdu.dk

Para-hexaphenylene (p6P) and methyloxylated quaterphenylene (MOP4) molecules form well-aligned, needle-like and blue light emitting aggregates (nanofibers) on mica substrates with interesting optical properties (1;2;3). Experiments have shown that these nanofibers have a high potential for applications in submicron-scaled photonics and electronics due to their extraordinary optical, morphological and also electrical properties.

One important application of organic nanoaggregates would be an implementation as frequency doubling elements in future integrated optical circuits. The possibility to functionalize para-phenylenes with electron push and pull groups and to obtain nanofibers from asymmetrically functionalized para-phenylenes should open a new route to nanoscaled frequency doublers.

In this work functionalized phenylene nanoneedles made from amino-methyloxylated quaterphenylenes (MOP4NH2) are grown on mica and are transferred onto SiO substrates for optical examination. When excited with femtosecond laser pulses the fibers are found to have a large non linear optical response and they exhibit pronounced second harmonic generation (SHG). In contrast, nanoneedles generated from non-functionalized phenylenes show SHG orders of magnitude weaker (Fig.1). The intensity of the SHG is investigated for single fibers as a function of excitation wavelength and excitation intensity. It is also shown using a laser scanning microscope that it is possible to image the fibers using second harmonic generation (Fig.2). This proofs that SHG imaging is an interesting, label-free new method which can be used as a complement to traditional fluorescence laser scanning microscopy.

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References:

[1] F.Balzer and H.-G. Rubahn, Growth control and optics of organic nanoaggregates. Adv.Funct.Mat., **15**:17 -- 24, 2005.
[2]M.Schiek, A. Luetzen, R. Koch, K. Al-Shamery, F. Balzer, R. Frese and H.-G. Rubahn, Nanofibers from functionalized para-phenylene molecules. App.Phys.Lett. **86** : 153107, 2005.
[3] J. Brewer, C. Maibohm, L. Jozefowski, L. Bagatolli and H.-G. Rubahn A 3D view on free-floating, space-fixed and surface-bound para-phenylene nanofibres. Nanotechnology, **16**:2396 -- 2401, 2005.

Figures:

Fig.1: Measured Second harmonic (red curves) and two-photon luminescence (blue curve) intensity from MOP4NH2, MOP4Cl and p6P nanofibers, transferred to SiO surfaces. Excitation at 790 nm with 100 fs and 4.5 mW.

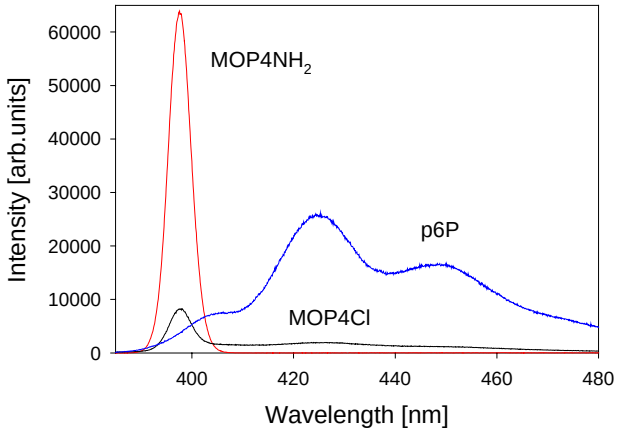

Fig.2: Two-dimensional imaging of MOP4NH2 nanofibers, using a femtosecond confocal microscope. The inset shows a dark field image of the same fibers.