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Towards 4D Characterization: 1D Time Resolved Femtosecond Spectroscopy and 3D Spatial Nanometer Spectrometry

Přednáška se bude konat pod záštitou děkana fakulty

Prof. RNDr. Bohuslava Gaše, CSc.

v rámci seriálu přednášek

Quo Vadis Chemie

v pondělí 6.května 2013 ve 14,00 hod.

posluchárna CH 2, Chemický ústav PřF UK na Albertově, Hlavova 8, Praha 2

Prof. RNDr. Jiří Barek, CSc.

předseda odborné skupiny analytické chemie ČSCH

Towards 4D Characterization:
1D Time Resolved Femtosecond Spectroscopy and
3D Spatial Nanometer Spectrometry

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A correlation between a structure and a function is a well defined concept in biochemistry and it is clearly relevant also for other fields of natural sciences. However, there is a third component - a time domain. To determine the changing structure in real time is then of interest, especially on molecular level.

This contribution represents an attempt to provide a unique overlap between the dynamics in 1D time and the structural characterization in 3D. Such 4D characterization can then provide a full picture of interacting molecular systems in time and space. Our experiments are based on two techniques, dynamics provided by time-resolved laser spectroscopy and spatial distribution provided by secondary ion mass spectrometry with approximate resolutions of 250 fs and of 0.17 nm, respectively.

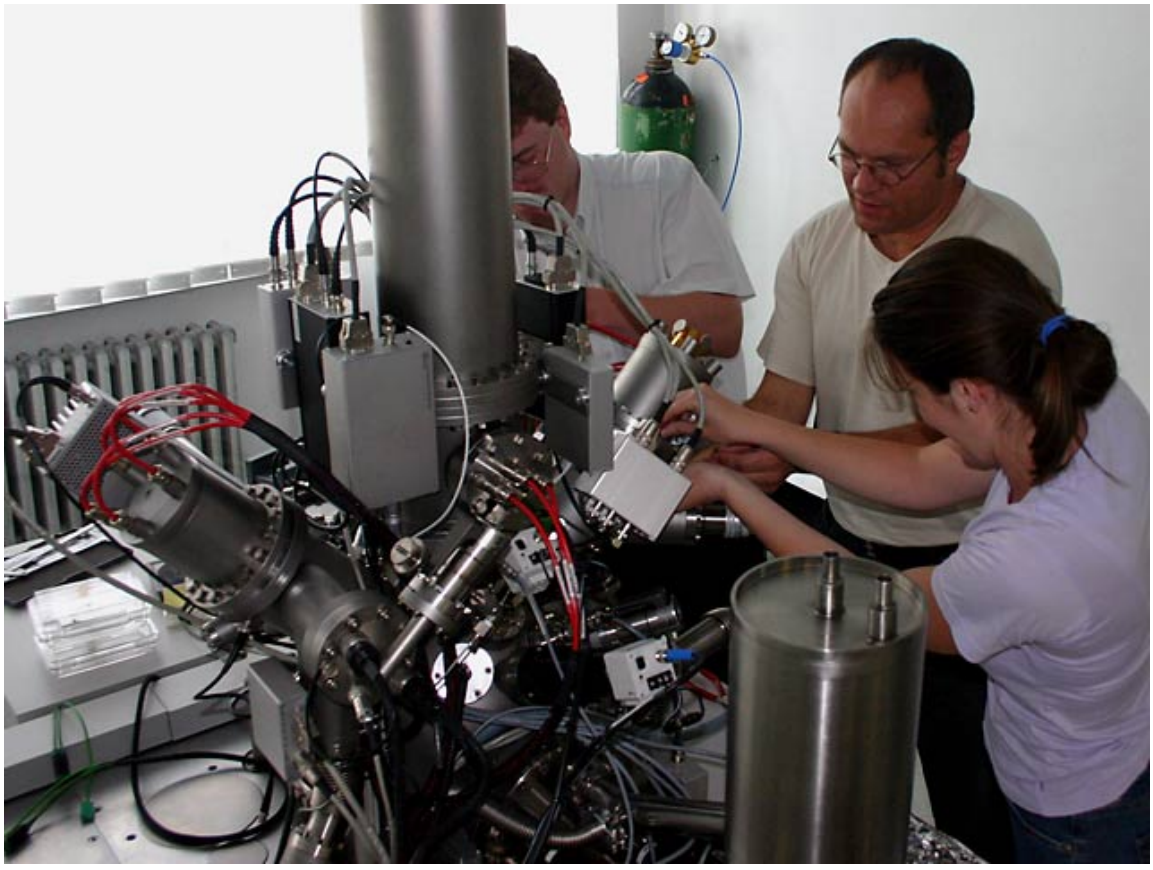
The concept is discussed on example of coumarin molecule interacting with layered alumino-silicate surface. A molecule of coumarin C522, $C_{14}H_{12}NO_2F_3$, is used as a fluorophore probe interacting with reduced-charge montmorillonite structure providing different Li^+ molar fractions [1].

The time-resolved fluorescence spectroscopy determine the decay time to be 1.0 ps and 3.6 ps for hydrophilic and hydrophobic surfaces, corresponding to different water solvation shell, respectively.

A spatial distribution by using secondary ion mass spectrometry is tested on alumino-silicate structure, where the distributions of Si, Al, Na, K, Mg, Fe, Mn, and Li are well resolved. The frozen structure of coumarin/water/ montmorillonite is determined to provide the structure between coumarin and water shell on the montmorillonite surface.

Concluding, the presented experiments shed some light on the 4D characterization.

[1] M. Zitnan, V. Szoecs, M. Janek, I. Bugar, J. Bdzoch, T. Palszegi, G. Link, and D. Velic, Langmuir 2009, 25(12), 6800–6807



Doc. Ing. Dušan Velič, PhD. (1966) pracuje v Medzinárodnom laserovom centre, kde je vedúcim Laboratória hmotnostnej spektroskopie sekundárnych iónov. Jeho laboratórium sa zaoberá analýzou materiálov so zameraním na chemickú kompozíciu povrchov a rozhraní materiálov. Zároveň pôsobí ako vysokoškolský pedagóg v odbore fyzikálna chémia na Univerzite Komenského v Bratislave (Prírodovedecká fakulta). Počas postdoktorandského pobytu v Nemecku spolupracoval dva roky s neskorším nositeľom Nobelovej ceny za chémiu (2007), prof. Ertlom.