Why aberration correction in TEM is so good for carbon materials – from imaging atoms to measuring reaction kinetics.

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Rapid spread of aberration correction in transmission electron microscopy in the last decade has opened lots of opportunities in structure research and characterization of materials, which were unthinkable before that. It has particularly boosted TEM research in nanocarbons as single carbon atoms became visible now. As a nice coincidence there came a Nobel Prize for the discovery of scotch tape method for graphite exfoliation, which has popped up graphene as a fashionable material to study.

In the lecture we will revise the principal limitations TEM has in respect to studying carbon materials and discuss how aberration correction helps to overcome all of them. I will show a number of examples of resolving structure of nanocarbon and it evolution under electron beam. Finally the question of obtaining the quantitative kinetic information from TEM data will be posed.

I will present the methodology we are developing, which applies the formalism and approaches of the classical chemical kinetics for the quantitative description of atomistic processes observable in the microscope. A proper statistical treatment of the data obtained in a range of experimental conditions allows determining of threshold energies for radiation induced reactions. But not only that: we show that true activation energies for thermally activated reaction pathways for individual defects can be estimated from TEM data as well.