STRUCTURAL STUDY OF GRAPHITE OXIDE HYDRATION: EFFECTS OF TEMPERATURE AND PRESSURE

A. Talyzin[a*]

[a]Department of Physics, Umeå University, Sweden
[*]Corresponding author: *Alexandr.talyzin@physics.umu.se*

Hydration of graphite oxide by excess of water was studied in the temperature interval 295-230K using synchrotron X-ray diffraction. Expansion of hydrated graphite oxide structure due to insertion of additional water occurs upon cooling down from ambient temperature to the point of water media freezing as evidenced from continuous shift of (001) reflection which corresponds to interlayer distance of graphite oxide structure. Structural breathing is found around the freezing point of H_2O and connected to insertion/expulsion of water to/from interlayer space. Cooling down below the point of water medium solidification results in stepwise contraction of graphite oxide interlayer distance by ∼25% due to partial withdrawal of water from the hydrated structure. Heating back from 230K to ambient temperature results in graphite oxide structure expansion due absorption of water from medium, thus making a reversible cycle. Structural breathing of graphite oxide was also studied at high pressure conditions using excess of basic or acidic water media. The lattice spacing of graphite oxide in excess of NaOH solution increases by 85% at 1.6 GPa. In contrast, structure expansion of graphite oxide immersed in liquid water with added HCl is significantly less pronounced compared to compression in pure water. The point of media solidification correlated with sharp decrease of graphite oxide layers separation due to partial withdrawal of water from the structure.
The effect of structure breathing is important for chemical treatments performed with graphite oxide in solution, e.g. graphite oxide functionalization and conversion into graphene-related materials.