Understanding the Chemistry of electron beam-induced transformations on the molecular level

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Dynamical processes at the nanoscale are difficult to investigate by state-of-the-art spectroscopic techniques, because they often rely on averaged datasets, or repeatable events. With aberration-corrected transmission electron microscopy, the resolution beyond the limit of light scattering was reached, which allows nowadays to study dynamic events microscopically at the nanoscale inn real-time. Herein described as single-molecule atomic-resolution real-time electron microscopy (SMART-EM), we aim to understand quantum chemical processes of single molecules and atoms. By means of statistical analysis of multiple events, or single-object statistical analysis, SMART-EM allows for the study of otherwise unnoted processes on the atomic/molecular level. However, with the utilization of high-energy electron irradiation, it becomes important to fully understand what effects are to be expected at the molecular level, in order to interpret the dynamic processes correctly. This is not only important on the single-molecule level, which are studied in vacuo, but also for the in-situ study of nanomaterials investigated in liquid media.

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