



## Analytical electron microscopy for carbon materials: Teaching old tricks to a young horse

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■ Electron energy loss spectroscopy (EELS) has for a long time been a standard method for materials characterization in Transmission Electron Microscopy (TEM). Recently, applying rigorous low dose regimes, it was even possible to study material phases in organic solar cells in 2D and 3D. However, sample damage by the electron beam has been a constant problem. In order to overcome this low energy TEM down to 20 keV electron energy has been studied extensively: With decreasing energy sample thickness becomes a major obstacle, limiting applications mainly to 2D materials.

Accepting the fact that beam damage can only be limited by reducing electron energies further (to about 1 keV or less), imaging with electrons can then only be obtained in a surface sensitive scanning mode.

We will discuss problems, advantages, and chances when imaging with a Scanning Electron Microscope (SEM) at landing energies in the range from 3keV down to 20 eV. Novel electron optical concepts allow such imaging at high resolution, and facilitate electron spectroscopic measurements on Backscattered Electrons (BSE) or Secondary Electrons (SE).

We will discuss first examples of polymer imaging, SE spectroscopy on organic materials and how these new techniques might in future be used for measuring spatially resolved work functions.