Damage to crystalline molecular layers caused by low energy electrons

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Research on organic and biological samples frequently involves exposing them to ionizing radiation. Such radiation generates secondary electrons with energies of a few electronvolts. These electrons are considered to be the main cause of damage to the samples.[1,2] In this work, we systematically expose crystalline layers of pentacene molecules to incident electrons with energies in the range 0-20 eV. The layers have a herringbone crystal structure and are grown in situ via sublimation in the UHV chamber of a Low Energy Electron Microscope[3], with real-time monitoring of growth and control over layer count. Interaction of low energy electrons with the pentacene layers gives rise to diffraction patterns. During imaging, the electrons also damage the crystal structure of the layers, resulting in fading of the diffraction patterns. We follow the fading over time as a function of incident electron energy, and study the dynamics of loss of crystal structure by spot profile analysis of the diffraction peaks (fig. 1). We observe a threshold around 6 eV where the rate of damage starts to noticeably increase, and find susceptibility to beam damage to be more than two orders of magnitude higher for electrons with energies around 20 eV compared to those closer to 0 eV. Furthermore, we compare the rate of disappearance of diffraction patterns for pentacene layers of different thicknesses.

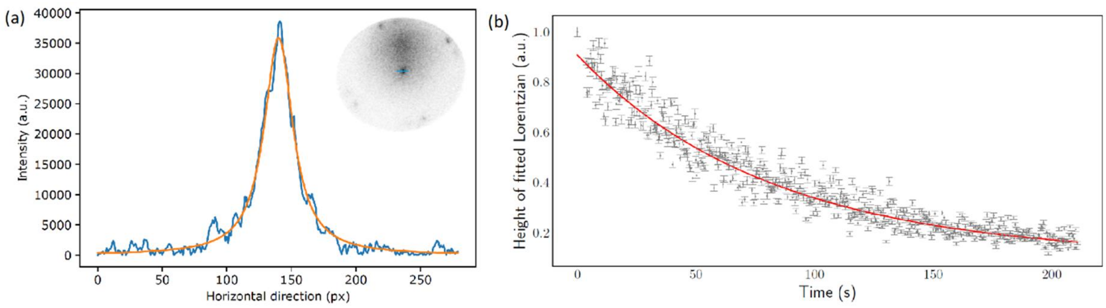

Figure 1. Zeroth order diffraction spot profile. (a) Lorentzian fit to a horizontal line profile through the zeroth order spot. The inset shows the diffraction pattern of the pentacene layer. (b) Decay of the height of the Lorentzian fit during exposure to 8 eV electrons.

References

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