Probing the behavior of single atoms, molecules and 2D layers using electron energy loss spectroscopy with low energy (30 keV and 60 keV) electrons

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The understanding of the behavior of small systems is fundamental for the design of material problems. In the limit, the properties of individual atoms and molecules will needed to be known. In view of the great advances of electron optics in the previous decades, electron spectro-microscopy is particularly well posed to probe these intrinsically small objects.

In this contribution, we will describe three groups of experiments involving materials with increasingly larger dimensionality. In particular, we will focus on the benefits of using lower energy electrons (30 keV and 60 keV) to perform EELS. We will start by showing how electron energy loss spectroscopy (EELS) can be used to probe the valence of individual Eu atoms exposed to oxygen. After, we will describe how the fine structure of core-loss EELS allows the distinction of fullerenes of different sizes confined in carbon nanotubes. Finally, we will discuss the use of low-loss EELS to map excitons in 2D dichalcogenides.