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Nanoscale investigation of local optical properties from low-dimensional materials by electron spectroscopy

Measurements of local optical properties are of great importance in designing nanoscale optoelectronic devices. Electron energy-loss spectroscopy (EELS) has been widely used for elemental identification in transmission electron microscopes (TEM) by using core-level excitations. Recent developments of monochromators after the e-beam guns has enabled us to access optical and vibrational ranges in the valence EELS regions from nanometric materials. Contrary to the core-level EELS, the valence EELS has a considerable delocalization effect which makes the local measurements intrinsically difficult. Here we show our continuous studies to develop the possibilities of valence EELS on low-dimensional materials. Attempts involve the local optical measurements of carbon nanotubes with atomic defects [1, 2], TMDC with various morphologies [3, 4, 5], and individual quantum dots [6]. We will also show our challenge to use a TEM as a full phonon spectrometer with a nanometer spatial resolution even for non-polar materials [7].
This work is partially supported by KAKENHI (JP16H06333).

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