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High Resolution Electron Energy Loss Spectroscopy with Simultaneous Energy and Momentum Mapping XUETAO ZHU, YANWEI CAO, SHUYUAN ZHANG, XUN JIA, QINLIN GUO, FANG YANG, Institute of Physics, Chinese Academy of Sciences, LINFAN ZHU, University of Science and Technology of China, LARRY KESMODEL, Indiana University, Bloomington, JIANDI ZHANG, WARD PLUMMER, Louisiana State University, JIANDONG GUO, Institute of Physics, Chinese Academy of Sciences — High resolution electron energy loss spectroscopy (HREELS) has been demonstrated as a powerful technique to probe vibrational and electronic surface excitations of solids. The dispersion relation of the surface excitations, i.e. energy as a function of momentum, can be obtained via the angle resolved measurements by rotating the sample or the analyzer in a conventional HREELS measurement. The sampling density in the momentum space and the detecting efficiency are restricted by the mechanical rotation. Here we introduce a new design of the HREELS system, by combining the traditional Ibach-type electron source with the mainstream hemispherical electron energy analyzer, which could simultaneously measure the energy and momentum of the scattered electrons without any mechanical rotation. The new system possesses higher efficiency and sampling density of momentum-resolved measurements by at least one order of magnitude than conventional spectrometers without deteriorating the resolution of energy and momentum. Using $Bi_2Sr_2CaCu_2O_{8+\delta}$ as an example, we show that an energy loss spectrum can be scanned throughout the first Brillouin zone and a momentum-dependent spectral intensity distribution could be obtained in one measurement.

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