

Non-Dipolar Asymmetry Parameters in Photoemission: Consequences for, and Measurements by, X-ray Standing Waves in Solids

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While photoemission is widely used in surface science, an implicit assumption is always that the dipole approximation provides an adequate description of the process under the conditions used in these experiments. In the case of photoemission-monitored normal incidence X-ray standing wave (NIXSW) structural studies of adsorbate structures, however, we have found that this is not the case, and that neglect of non-dipolar contributions to the angular dependence of the photoemission can lead to significant systematic errors in the structural parameters deduced. While a proper knowledge of the non-dipolar asymmetry parameters is therefore essential for the proper interpretation of these experiments, the NIXSW method, with suitable choice of samples, can actually be used to measure these parameters in a particularly simple way on high-density (solid) samples. In this paper the physical principles of NIXSW and the impact of non-dipolar asymmetry parameters will be described, together with the results of measurements of the asymmetry parameter for 1s photoemission from all elements from C to Cl at photon energies around 3 keV. Some of the systematics of these results, and the implications for future NIXSW experiments will be discussed.