Surface core-level shift (CLS) of photoemission spectroscopy (PES) has not only played a very important role in understanding the surface electronic structures, but also been a powerful tool for studying the surface atomic structures. This is because the CLS is very sensitive to the chemical environment of surface atoms. To obtain accurate CLS, it is required first to make the surface homogeneous; otherwise the line shape of the spectrum may be incorrect to resolve.

In the report, we will show the study of Si2p core-level spectroscopy of the Au adsorbed Si(111) – √3 × √3 – Ag surface to illustrate the importance of homogeneity. We chose this surface because like other monovalent atoms such as Ag, Cu and alkali metals (Na, K, Rb and Cs), Au adatoms on the √3 – Ag surface may induce a new surface phase with 2√3 × 2√3 period, which has attracted researchers with its high surface conductance comparing to the substrate of √3 – Ag [1]. All of the 2√3 × 2√3 surfaces have a similar electronic structure, which explained the high surface conductance very well. Therefore, the resolving of their CL spectroscopy is naturally thought to be similar. Previous Si2p CL studies have been performed on the Ag, K, Cs and Na induced 2√3 × 2√3 phases, but not on the Au induced one. Although all the line shapes of the Si2p CL spectra of different 2√3 × 2√3 surfaces appear similar, they were interpreted in different resolutions.

We measured the Si2p CL spectra of not only the Au induced 2√3 × 2√3 surface but also the √3 – Ag surface with different Au coverage. A strong dependence of the spectrum line shapes on the Au coverage was discovered. At very low (~0.01 ML) and saturate (~0.14 ML, to form 2√3 × 2√3 phase) Au coverage, the spectra could be resolved reasonably, while at medium Au coverage, they changed drastically and were very difficult to be resolved. With scanning tunneling microscopy (STM) observations on the √3 – Ag surface at different Au coverage, we interpreted the medium spectra by combining the spectra of low and saturate Au coverage’s. Such phenomena can be illustrated well in the terms of local band bending, which is result from the inhomogeneity of surfaces.