

Electron Spectroscopy Study of Rare-earth Trihalides

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Double peak structure in the photoemission spectra of rare-earth compounds has been a controversial problem for many years. There are two models to describe them. One is the charge transfer model which proposes that the hybridization between 4f level and valence band gives rise to the satellites. The other is the 5d screening model proposing that double peaks are due to two different screening channels by 5d conduction electron. Several years ago, Fujimori *et al.* reported 4f-derived UV photoemission spectra of rare-earth trihalides and claimed that the charge transfer model would be adequate for double peaks structures. We have studied the core level XPS of rare-earth trihalides ($\text{LaF}_3, \text{LaCl}_3, \text{CeF}_3, \text{CeCl}_3$) along with valence band XPS and BIS (Bremsstrahlung Isochromat Spectroscopy). From Gunnarsson-Schönhammer model approach, double peaks in the 3d spectra were described within the charge transfer model scheme. It is consistent with Fujimori's 4f-derived photoemission work. The double peaks structure in XPS (valence and core) of rare-earth compounds would be due to the charge transfer mechanism from the valence band to the unfilled 4f level through hybridization, not two screening channels by 5d conduction electron. In the higher binding energy side (10~40 eV) of 3d XPS, several unknown satellites were observed. Through comparing with the other core level XPS and EELS, we found that they were mainly loss structures and some 'intrinsic' plasmon excitation structure. In loss spectra, the interesting loss structures from charge transfer transition and 5p excitation were found.