Synchrotron-radiation Photoemission Study on the Interaction of Rubrene with Metals (Ag, K)

C.-P. Cheng (鄭秋平)[1,2], J.-F. Shiue (薛智豐)[2], S.-W. Fang (方紹為)[2], and T.-W. Pi (皮敦文)[3]

[1]Department of Applied Physics, National Chiayi University, Chiayi, Taiwan
[2]Graduate Institute of Optoelectronics and Solid State Electronics, National Chiayi University, Chiayi, Taiwan
[3]National Synchrotron Radiation Research Center, Hsinchu, Taiwan

In this report, we have used synchrotron-radiation photoemission spectroscopy to study the interaction of rubrene with metals (Ag, K). For the rubrene/Ag system, rubrene molecules are physisorbed on the Ag surface. The pillow effect results in the vacuum level shift. For the Ag/rubrene system, Ag atoms hybridize with rubrene molecules. An interfacial dipole layer formed via the charge transfer Ag to rubrene leads to the vacuum level shift away from the Fermi level. For the K/rubrene system, we have found that upon the K doping, the K atoms continuously diffuse into the substrate. The doping induces the energy level shift and molecular orbital change at different doping level that can be separated into two different stages. The first stage is predominantly due to the Fermi level moving in the energy gap as a result of the doping of electrons from the K to the rubrene, and the second stage is characterized by a significant modification of molecular orbital and the introduction of a new gap state. A pronounced shift of the vacuum level was observed, indicating the formation of an interfacial dipole. Theses results suggest that the molecular nature and strong correlation must be considered for the K doping in rubrene.

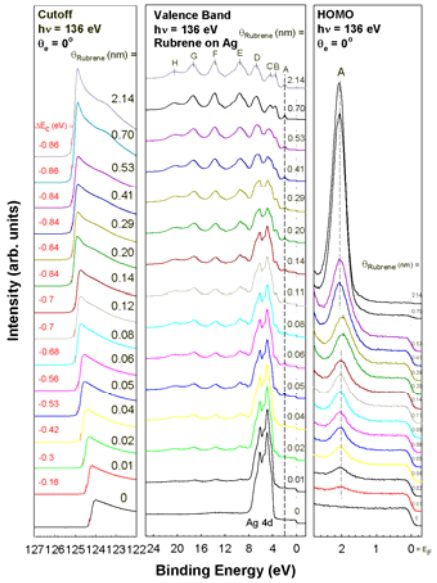

Fig. 1: Valence-band spectra recorded at a photon energy of 136 eV for rubrene adsorption on Ag.The right panel is a magnification of the spectra at the vicinity of the E_F and the HOMO, while the left panel presents the low-energy cutoff.

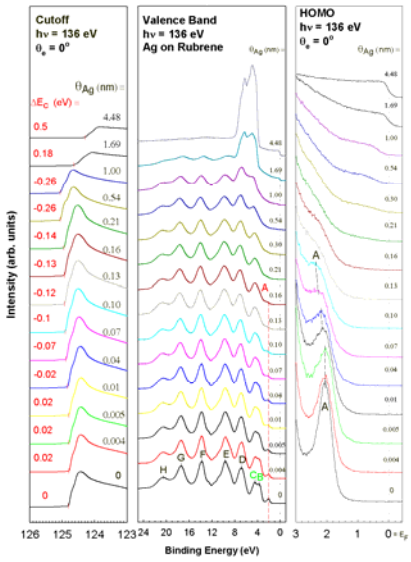

Fig. 2: Valence-band spectra recorded at a photon energy of 136 eV for Ag adsorption on rubrene.The right panel is a magnification of the spectra at the vicinity of the E_F and the HOMO, while the left panel presents the low-energy cutoff.

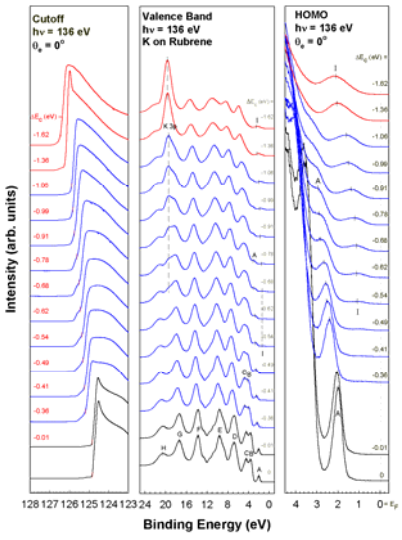

Fig. 3: Valence-band spectra recorded at a photon energy of 136 eV for K adsorption on rubrene.The right panel is a magnification of the spectra at the vicinity of the E_F and the HOMO, while the left panel presents the low-energy cutoff.