Dynamic and Static Charge Transfer Investigation in two dimensional MoS_2/Graphene and MoS_2/SiO_2 Heterostructures: A spectroscopy combination Approach.

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Abstract
In this work we performed for the first time charge transfer dynamics characterization in MoS_2/SiO_2 and MoS_2/graphene heterostructures using the core hole clock (CHC)method within the framework of synchrotron light based resonant Auger spectroscopy (RAS) around sulfur absorption K edge. The results show that charge transfer in atomically thin MoS_2/graphene for electron excited from S1s to 3p unoccupied electronic states is 2 times faster than MoS_2/SiO_2 heterostructure. We found that fast electron transfer between MoS_2 monolayer and graphene substrate are associated with energy position of S1s-3p transitions above the graphene Fermi level and the high density of empty electronic states of graphene layers. The results obtained from CHC method were confirmed by other non-dynamic spectroscopy techniques such as photoluminescence (PL) and Raman.

References

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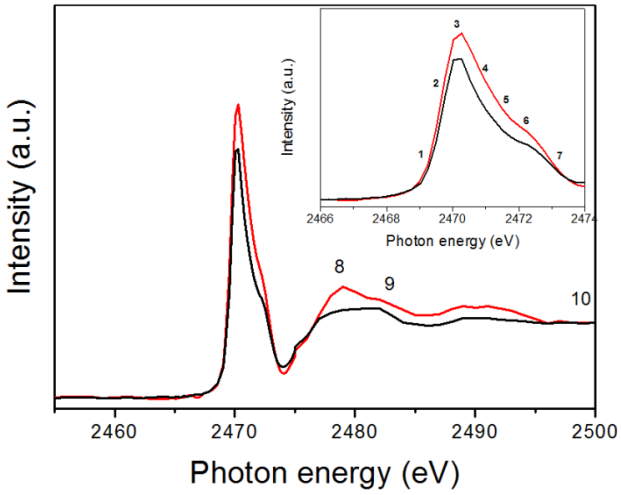

Figure 1: S-K edges NEXAFS spectra of $MoS_2/SiO_2/Si$ (black) and MoS_2/Graphene/SiO_2/Si (red) heterojunctions collected at 45° incidence angle. The inset show a zoom at resonance peaks numbering the photon energies used to obtain S-K $L_{2,3}$ $L_{2,3}$ RAS spectra.

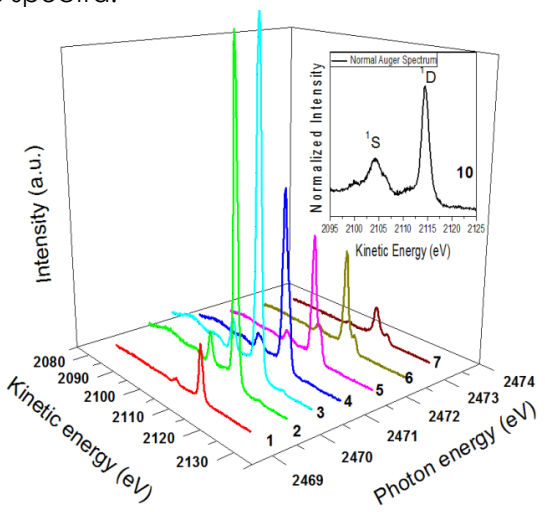

Figure 2: S-K $L_{2,3}L_{2,3}$ RAS spectra measured at photon energies labeled as 1-7 in S1s-NEXAFS spectrum for $MoS_2/SiO_2/Si$ sample. The non-resonant Auger spectra collected at photon energy called 10 is show as inset.

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