One-and two-photon photoemission from silicon surfaces

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One-and two-photon photoelectron spectra with the same total photon energy should give information on the same initial and final states. Differences show the influence of intermediate states in two-photon photoemission (2PPE). Of particular interest are also bulk bands where the conservation of perpendicular momentum leads to peak shifts, resonances and peak narrowing [1,2].

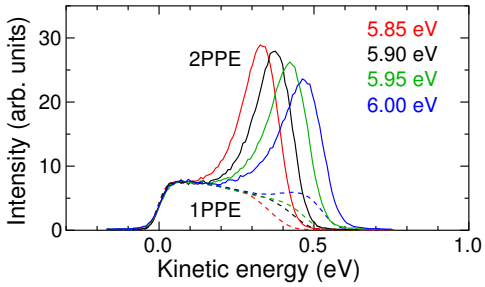

Figure 1: One- and two-photon photoemission spectra in normal emission from Si(100)(2×1) for the same total photon energy and p-polarized light.

We have measured 1PPE and 2PPE from Si(100)(2×1) using the 4$^{\text{th}}$ and 2$^{\text{nd}}$ harmonic from a Ti:sapphire laser (see Fig. 1). From the photon energy dependence we assign the 2PPE peak to the occupied dangling bond state D_{down}. However, the peak is observed weakly in 1PPE for 6 eV photon energy only. Obviously, 2PPE spectra from D_{down} are strongly influenced by intermediate states which could be related to unoccupied bridge bonds [3].

Bulk transitions observed in 1PPE are seen in 2PPE on some Si surfaces and not on others. Based on these observations we try to develop a consistent picture of the relationship between one- and two-photon photoemission.

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[3] J. Pollmann *et al.*, Appl. Phys. A **41**, 21 (1986).