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Positron Auger Electron Spectroscopy (PAES) studies of the Si(100) and Si(111) surfaces

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The measurements of the Auger spectra induced by positron annihilation obtained from the clean reconstructed Si(100)-(2x1) and Si(111)-(7x7) surfaces will be presented. A strong Auger signal corresponding to the L_{2,3}VV Auger transition of Si atom is observed. The difference of the 2p-core annihilation probabilities from two different reconstructed surfaces of the same element show the sensitivity to a specific atomic structure of the topmost layers. Also, measurement of the decrease in the PAES intensity for the Si substrate as a function of increasing gas exposure can be used to determine the sticking coefficients of hydrogen and oxygen. Theoretical calculations indicate that the decrease in the Si PAES intensity is due to the fact that hydrogen on the surface pushes the positron wave function away from the Si substrate reducing the positron overlap (and consequently the probability of annihilation) with the Si core electrons. These results demonstrate that unlike most surface science techniques, PAES is sensitive to the presence of hydrogen on the surface and is therefore a valuable new tool in hydrogen adsorption and related measurements.