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High-Temperature Phase Transitions on the Si(111) Surface

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Surface melting of semiconductors has been widely studied up to now. Recent theoretical⁽¹⁾ and experimental⁽²⁾ results suggest that the Si(111) surface undergoes an incomplete melting at high temperature below the bulk melting point (1680 K). In this work, angle resolved ultra-violet photoemission spectroscopy was performed to investigate the phase transitions on the Si(111) surface with rising temperature from room temperature (RT) up to 1600 K. By analyzing of the integrated emission intensity at the Fermi level, we observed a change of metallic character as a function of temperature.⁽³⁾ As previously reported, the Si(111) 7x7 surface has metallic nature at RT. A linear increase with temperature and an abrupt rise of the intensity at the critical temperature ($T_c=1100\text{K}$) is observed. At the same time, the Si(111) surface structure transforms from the (7x7)-DAS to the high temperature 1x1 structure. At 1470 K, the decrease in its metallicity shows the presence of another phase transition taking place at about 200 K below the bulk melting point. Based on these results, we'll discuss the origin of the two phase transitions on the Si(111) surface at elevated temperatures.

[Reference]

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