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Low Dose Ion Irradiation of Si(111)7x7 Structures

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Pending the arrival of our new O⁺ ion source, we started to investigate lower energy effects of irradiation of the Si(111)7x7 surface. This is an ideal target for looking for differences between chemical and mechanical effects of low-energy ions. Using a commercial ion-gun source, we started by calibrating the damage rate on Si(111)7x7 surfaces with Ar⁺ ions, moving eventually to O⁺ ions. We found that changes occurred very slowly under 200eV irradiation, probably because of reduced efficiency of the gun-source. At 500eV, the damage occurred relatively rapidly.

After 2 weeks of experiments up to Sept 2001, we already encountered one unexpected new result. The faulted and unfaulted sides of the Si(111)7x7 surface became modified at different rates. The pure, clean surface has an accidental p6mm symmetry, which is higher than the bulk p3m1 symmetry. This happens because the faulted and unfaulted sides in the Takayangi DAS model surface happen to be exact mirror images of each other. The stacking fault therefore has apparent perfect tetrahedral bonding present. Our observation was that the twelve {7,3,0,2} equivalent surface reflections separated into two groups of six with different intensity after irradiation. This result, if confirmed, will lead to important conclusions about the cooperative interactions between target-atom orientations under low-energy irradiation.

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