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ON DISTINGUISHING BETWEEN SMALL VACANCY AND INTERSITITIAL DISLOCATION LOOPS USING A NON-CONVENTIONAL WEAK BEAM DARK FIELD TECHNIQUE

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It is well known that both the burgers vector and the habit plane of dislocation loops are needed in order to determine their type, e.g. vacancy or interstitial. The conventional bright field and dark field techniques give a dislocation image width ≈300Å or an image shift from the core position even larger than the true size of a small dislocation loop. This makes loop type determination very difficult.

In this paper, the newly developed weak beam dark field technique[(1)], which decreases the effective extinction distance, ξg, has been used to reduce the dislocation image width ($\sim\frac{1}{3}\xi g$), so that the shape (habit plane) and loop types of small dislocation loops (<500Å) can be determined unambiguously.

Figures (a) - (f) show the W.B.D.F. picutres taken with the indicated diffracting $\bar{g}$ vectors (s>0) of small dislocation loops and rod-like defects formed after post-implantation anneals at 800°C for 20 minutes in boron ion implanted ($2 \times 10^{14}/cm^2$) silicon. Figures (a) and (b) were taken near <111> orientation. Note that the shapes of most loops are clearly resolved to be hexagonal with edges along <110> directions. From trace analysis, loop a, b and c lie on the inclined {111} planes, which loop d is on the foil plane. This was also proven when the foil was tilted from <111> to <11$\bar{2}$> orientation as shown in Figs. (c) - (f), so that loops c show edge on in Figs. (e) and (f), and loops a show edge on in Fig. (c) and (d). Since loop a and d show residual contrast ($\bar{g}.\bar{b} = 0$, $\bar{g}.\bar{b} \times \bar{u} \neq 0$) when the operating $\bar{g}$ vector is on the loop planes as shown in Figs. (a) and (b), this suggests that this dislocation is a Frank sessile. This was further substantiated in Fig. (c), where the fringes contrast due to the stacking fault of loop c is clearly seen.

From contrast analyses, it is therefore concluded that most of the small dislocation loops fromed after post-implantation annealing in boron ion implanted silicon are interstitial type Frank sessile loops on all four {111} planes.

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(1) Cockayne, D. J. H., Z. Natur Forsch. 27a, 452, (1972).

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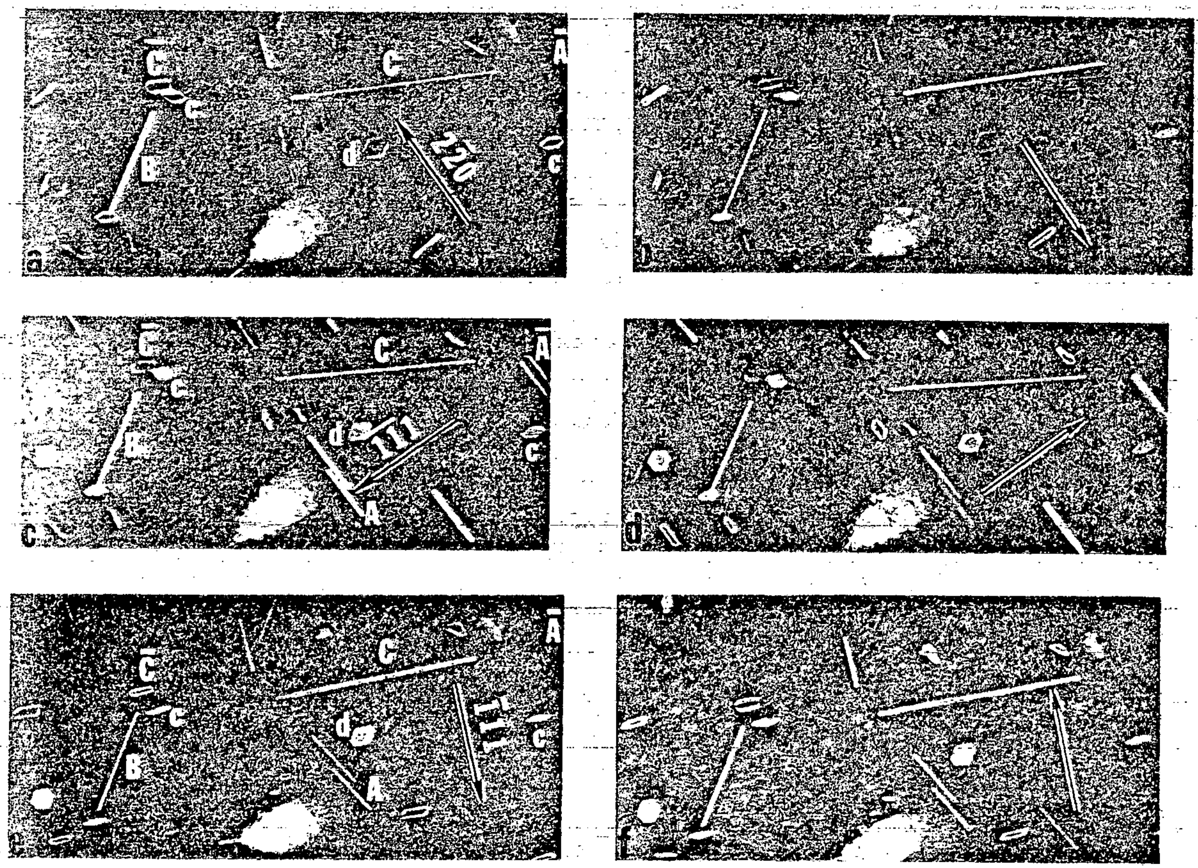

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Fig. 1. The weak beam dark field pictures of small residual defects after post-implantation annealing of boron ion implanted silicon.

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