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

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Wei-Kuo Wu

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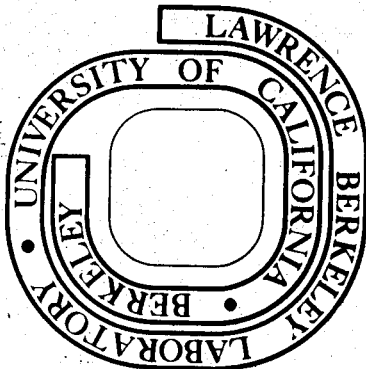
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ON DISTINGUISHING BETWEEN SMALL VACANCY AND INTERSTITIAL DISLOCATION LOOPS  
USING A NON-CONVENTIONAL WEAK BEAM DARK FIELD TECHNIQUE

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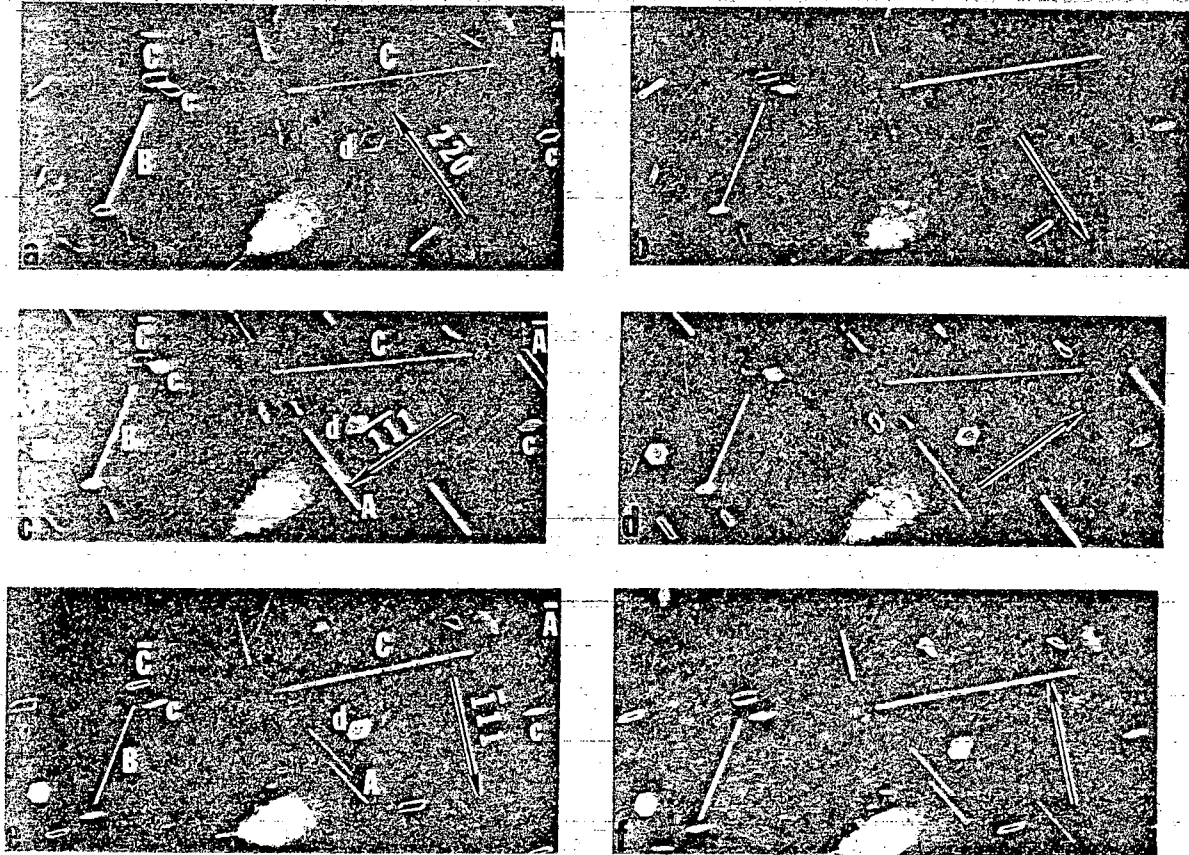
It is well known that both the burgers vector and the habit plane of dislocation loops are needed in order to determine their type, e.g. vacancy or interstitial. The conventional bright field and dark field techniques give a dislocation image width  $\approx 300\text{\AA}$  or an image shift from the 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<sup>(1)</sup>, which decreases the effective extinction distance,  $\xi_g$ , 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 ( $<500\text{\AA}$ ) can be determined unambiguously.

Figures (a) - (f) show the W.B.D.F. pictures taken with the indicated diffracting  $g$  vectors ( $s > 0$ ) of small dislocation loops and rod-like defects formed after post-implantation anneals at  $800^\circ\text{C}$  for 20 minutes in boron ion implanted ( $2 \times 10^{14}/\text{cm}^2$ ) silicon. Figures (a) and (b) were taken near  $\langle 111 \rangle$  orientation. Note that the shapes of most loops are clearly resolved to be hexagonal with edges along  $\langle 110 \rangle$  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  $\langle 111 \rangle$  to  $\langle 112 \rangle$  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 ( $\bar{g} \cdot \bar{b} = 0$ ,  $\bar{g} \cdot \bar{b} \times \bar{u} \neq 0$ ) when the operating  $g$  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 formed after post-implantation annealing in boron ion implanted silicon are interstitial type Frank sessile loops on all four  $\{111\}$  planes.

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



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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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