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Eugene E. Haller and William L. Hansen

March 1973

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# A DISLOCATION ETCH FOR 1,1,3 PLANES IN GERMANIUM*

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March 1973

Many chemical etch formulations are known which give etch pits for dislocations which are nearly normal to the principal crystal planes in germanium. The characteristics of many of these etches have been tabulated by Holmes[1]. Recently we have been growing crystals in which the growth axis is purposely selected to be distant from the principal axes and, for this program, the 1,1,3 axis was selected. No etch formulations could be found in the literature which would reveal dislocations on 1,1,3 planes--this leads to difficulties in evaluating crystal grower parameters.

A solution to this problem, which was used for some time, was to locate the nearest 1,1,1 plane by optical alignment, slice the crystal on this plane and etch with Fimicyanide etch[2]. However, this procedure was very time consuming and, further, destroyed the crystal for its intended purpose (large radiation detectors).

After experimenting with many etch compositions, it was found that substituting $H_2O_2$ for $HNO_3$ in $Cu(NO_3)$ etch[3] gave well defined etch pits for dislocations normal to the 1,1,3 plane. The etch composition is $HF:H_2O_2:Cu(NO_3)_2$, 2:1:1, where the HF is 50% concentration, the $H_2O_2$ 30% and the $Cu(NO_3)_2$ 10%.

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* This work was done under the auspices of the United States Atomic Energy Commission.

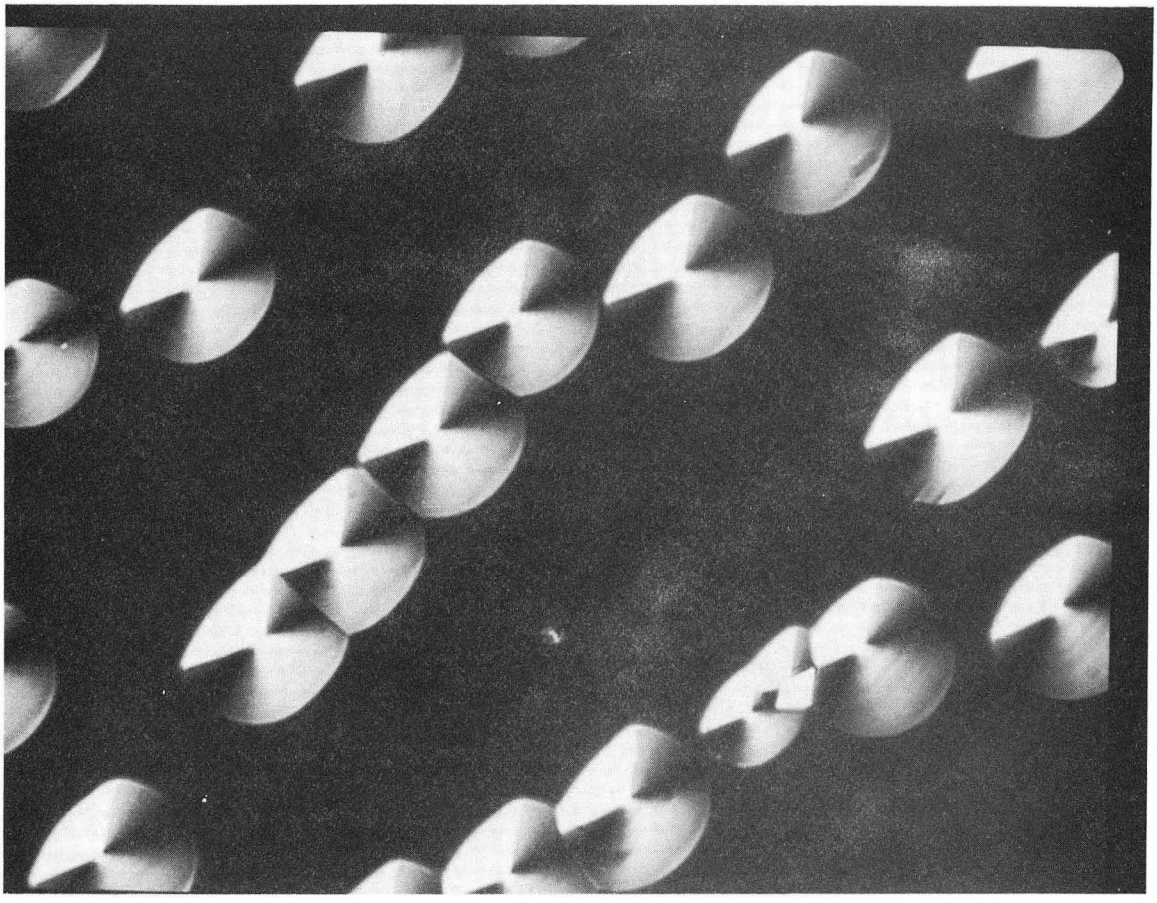
Since the etch is short lived due to too low pH for $H_2O_2$ stability, it is prepared immediately before use or, preferably, the ingredients are precooled below ambient temperature and then mixed. The most consistent results have been obtained with a six minute etch at 22°C. The figure shows the etch pits after this treatment. This etch, as formulated, does not reveal 1,1,1 etch pits and gives erratic results on the 1,0,0 plane. However, the addition of 1/20 part glacial acetic acid will give acceptable results on these planes. No other dislocation directions were tested due to lack of samples.

## REFERENCES

1. Holmes, P. J., The Electrochemistry of Semiconductors, Academic Press, New York (1962).

2. Billig, E., Proc. Roy. Soc., A235, 37 (1956).

3. McKelvey, J. P. and Longini, R. L., J. Appl. Phys., 25, 634 (1954).



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