



**HAL**  
open science

# HIGH SPATIAL RESOLUTION ELECTRON BEAM INDUCED CURRENT

Jean-Luc Maurice

► **To cite this version:**

Jean-Luc Maurice. HIGH SPATIAL RESOLUTION ELECTRON BEAM INDUCED CURRENT. Journal de Physique Colloques, 1989, 50 (C6), pp.C6-153-C6-153. 10.1051/jphyscol:1989613 . jpa-00229644

**HAL Id: jpa-00229644**

**<https://hal.science/jpa-00229644>**

Submitted on 4 Feb 2008

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

## HIGH SPATIAL RESOLUTION ELECTRON BEAM INDUCED CURRENT

J.-L. MAURICE

*CNRS, Laboratoire de Physique des Matériaux, F-92195 Meudon, France*

Spatial resolution  $\delta_r$  of the Electron Beam Induced Current (EBIC) contrast can be defined as the width at half maximum of the contrast profile across a defect. It depends mainly on beam spreading, but in the case of grain boundaries (GBs), it is also very dependent on the minority carrier diffusion length  $L$ . In silicon with  $L = 100 \mu\text{m}$  for instance,  $\delta_r = 40 \mu\text{m}$  at 30 kV [1], value far too large to establish correlations with microstructure.

A good means to provide better resolution is to perform EBIC on thin Transmission Electron Microscopy (TEM) specimens, where both beam spreading and effective diffusion length are reduced. Moreover, this also allows direct correlation with microstructure[2].

Experiments reported here make clear some limits which appear when measuring EBIC on thin samples.

Material was p-type silicon, boron doped to  $10^{16} \text{ cm}^{-3}$ , either bi-or poly-crystalline, with  $L$  ranging from 15 to 30  $\mu\text{m}$ . Schottky contacts were deposited by thermal evaporation of Al, after ion milling and chemical polishing of the samples ( $\text{HNO}_3$  [65 %],  $\text{CH}_3\text{COOH}$  [99,8 %], HF [48 %]: 16:3:1). Preliminary experiments showed that EBIC vanished in zones thinner than  $\approx$  one  $\mu\text{m}$ . This limit varied slightly with accelerating voltage : EBIC could be collected in thinner zones when beam voltage was lowered, confirming greater generation near surface at low voltage. In other respects, the EBIC disappearance in thin parts of foils recalls the one observed in bulk samples when lowering beam voltage, the same limitations due to surface proximity seem to occur.

The resolution test was realized at 30 kV on a bicrystalline thin sample, with GB running from thick to thin zones. The GB was  $\{710\} \Sigma = 25$ , annealed, with recombination velocity - measured through Donolato method [3] on bulk samples - greater than  $10^3 \text{ ms}^{-1}$ . Contrast was nearly continuous in bulk, with  $\delta_r = 15 \mu\text{m}$ .  $\delta_r$  decreased to  $\approx 1 \mu\text{m}$  in zones a few  $\mu\text{m}$  thick, letting appear strong variations. A local contrast enhancement could thus be associated to a precipitate seen with 100 kV TEM. Good quantitative correlation EBIC-TEM was limited by the fact that EBIC contrast was no longer interpretable as recombination contrast in thinner zones (effects of preferential etching obviously played a major role).

In conclusion, more than one order of magnitude may be gained on spatial resolution of GB EBIC contrast by performing measurements on thin samples. Qualitative direct correlation with TEM image is also obtainable. To get more quantitative TEM-EBIC however, special effort must be paid to sample surface preparation as well as to signal detection.

[1] : J. MAREK, J.Appl.Phys. 53 (3), 1454 (1982)

[2] : P. M. PETROFF, D. V. LANG, J.-L. STRUDEL and R. A. LOGAN, Scanning Electron Microscopy 1978, ed. by O. Johari, SEM inc., AMF O'Hare, 1, 325 (1978)

[3] : C. DONOLATO, J.Appl.Phys. 54 (3), 1314 (1983)