

## LAMPIRAN



## LAMPIRAN A

### Data Ukuran Bahan Silikon Amorf Terhidrogenasi

Bahan	Panjang (cm)	Lebar (cm)	Luas (cm <sup>2</sup> )
1	0,848 ± 0,004	0,643 ± 0,012	0,545 ± 0,002
2	1,096 ± 0,006	0,746 ± 0,002	0,837 ± 0,008
3	0,951 ± 0,006	0,795 ± 0,013	0,756 ± 0,015
4	1,087 ± 0,008	1,026 ± 0,018	1,115 ± 0,018
5	1,063 ± 0,021	0,995 ± 0,019	1,058 ± 0,027
6	0,848 ± 0,017	0,638 ± 0,008	0,541 ± 0,003
7	1,033 ± 0,003	0,855 ± 0,018	0,883 ± 0,002
8	0,878 ± 0,017	0,813 ± 0,008	0,714 ± 0,002
9	1,093 ± 0,004	1,031 ± 0,011	1,127 ± 0,011
10	1,129 ± 0,010	0,879 ± 0,007	0,992 ± 0,013
11	0,818 ± 0,002	0,686 ± 0,007	0,561 ± 0,009
12	0,978 ± 0,012	0,838 ± 0,004	0,819 ± 0,014
13	0,905 ± 0,015	0,737 ± 0,003	0,667 ± 0,002
14	1,037 ± 0,003	1,047 ± 0,003	1,086 ± 0,004
15	1,071 ± 0,016	0,729 ± 0,034	0,781 ± 0,004

## LAMPIRAN B

### B. Perhitungan Dosis Ion Dopan

#### B.1. Luas Cawan Faraday (*Faraday Cup*)

Diameter cawan Faraday sebagai pemegang bahan target ( $4,033 \pm 0,033$ ) cm.

Luas rata-rata cawan Faraday (fc) yaitu

$$\overline{A}_{fc} = \frac{1}{4}\pi d_{fc}^2 = \frac{1}{4}\pi 4,033^2 = 12,775 \text{ cm}^2$$

Simpangan baku luas cawan Faraday yaitu

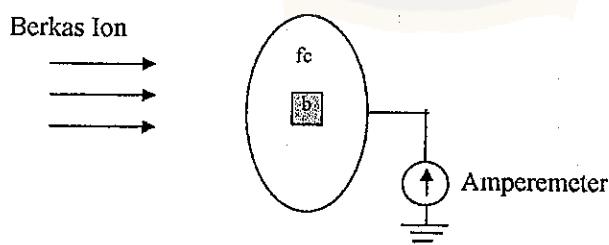
$$S_{A_{fc}} = \sqrt{S_{d_{fc}}^2 \left( \frac{\partial A_{fc}}{\partial d_{fc}} \right)^2}$$

$$\frac{\partial A_{fc}}{\partial d_{fc}} = \frac{1}{2}\pi 4,033 = 6,335$$

$$S_{A_{fc}} = \sqrt{(0,033 \cdot 6,335)^2} = 0,209 \text{ cm}^2$$

Luas cawan Faraday adalah ( $12,775 \pm 0,209$ )  $\text{cm}^2$ .

#### B.2. Dosis Ion Dopan



Arus ion pada sampel dihitung dengan

$$I_{fe} = \frac{A_{fc}}{A_{fc} - A_{fb}} I_{fcb}$$

$$\begin{aligned}
 I_b &= I_{fc} - I_{fcb} \\
 &= \left( \frac{A_{fc}}{A_{fc} - A_b} I_{fcb} \right) - I_{fcb} \\
 &= \left( \frac{A_b}{A_{fc} - A_b} \right) I_{fcb}
 \end{aligned}$$

Dosis ion dopan yang dihitung menurut persamaan (2-4) yaitu

$$\begin{aligned}
 C_s &= \frac{I_b t}{m q A_b} \\
 &= \frac{\left( \frac{A_b}{A_{fc} - A_b} \right) I_{fcb} t}{m q A_b} = \frac{I_{fcb} t}{m q (A_{fc} - A_b)}
 \end{aligned}$$

#### Keterangan

$I_{fc}$  adalah arus ion yang terbaca pada amperemeter ketika cawan Faraday tanpa diberi sampel/bahan (Ampere),  $I_{fcb}$  adalah arus ion yang terbaca pada amperemeter ketika cawan Faraday diberi bahan (Ampere),  $I_b$  adalah arus ion pada bahan (Ampere),  $A_{fc}$  adalah luas cawan Faraday ( $\text{cm}^2$ ),  $A_b$  adalah luas bahan ( $\text{cm}^2$ ),  $t$  adalah waktu implantasi (detik),  $m$  adalah jumlah muatan (untuk ion tunggal sama dengan satu), dan  $q$  adalah muatan elektron ( $1,6 \times 10^{-19}$  Coulomb).

Simpangan baku dosis ion dopan dirumuskan

$$\begin{aligned}
 S_{C_s} &= \left[ \left( S_{I_{fcb}} \frac{\partial C_s}{\partial A_{fcb}} \right)^2 + \left( S_t \frac{\partial C_s}{\partial t} \right)^2 + \left( S_{A_{fc}} \frac{\partial C_s}{\partial A_{fc}} \right)^2 + \left( S_{A_b} \frac{\partial C_s}{\partial A_b} \right)^2 \right]^{\frac{1}{2}} \\
 \frac{\partial C_s}{\partial I_{fcb}} &= \frac{t}{m q (A_{fc} - A_b)} \\
 \frac{\partial C_s}{\partial t} &= \frac{I_{fcb}}{m q (A_{fc} - A_b)} \\
 \frac{\partial C_s}{\partial A_{fcb}} &= -\frac{I_{fcb} t}{m q (A_{fc} - A_b)^2}
 \end{aligned}$$

$$\frac{\partial C_s}{\partial A_b} = \frac{I_{feb} t}{m q (A_{fc} - A_b)^2}$$

$$S_{C_s} = \frac{I_{feb} t}{m q (A_{fc} - A_b)} \left[ \left( \frac{S_{I_{feb}}}{I_{feb}} \right)^2 + \left( \frac{S_t}{t} \right)^2 + \left( \frac{S_{A_{fc}}}{(A_{fc} - A_b)} \right)^2 + \left( \frac{S_{A_b}}{(A_{fc} - A_b)} \right)^2 \right]^{\frac{1}{2}}$$

dengan

$$S_{I_{feb}} = 10^{-6} \text{ Ampere}$$

$$S_t = 0,1 \text{ detik}$$

$$S_{A_{fc}} = 0,209 \text{ cm}^2$$



### B.3. Data Perhitungan Dosis Ion Dopan

Bahan	Energi Ion (keV)	Arus Ion ( $\times 10^{-6}$ Ampere)	Waktu Implantasi (detik)	Dosis Ion ( $\times 10^{15} \text{ cm}^{-2}$ )
1	30	10	300	$1,533 \pm 0,030$
2	30	10	600	$3,141 \pm 0,063$
3	30	10	1200	$6,240 \pm 0,633$
4	30	10	2400	$12,864 \pm 1,307$
5	30	10	3600	$19,203 \pm 1,957$
6	60	10	300	$1,533 \pm 0,155$
7	60	10	600	$3,153 \pm 0,320$
8	60	10	1200	$6,218 \pm 0,631$
9	60	10	2400	$12,878 \pm 1,308$
10	60	10	3600	$19,095 \pm 1,939$
11	10	10	600	$4,070 \pm 0,413$
12	20	10	900	$4,705 \pm 0,478$
13	30	10	720	$4,717 \pm 0,479$
14	60	10	1200	$4,416 \pm 0,448$

## LAMPIRAN C

### Data Pengukuran Hambatan Lapis dan Resistivitas

#### C.1. Pengukuran Hambatan Lapis dan Resistivitas Sebelum Implantasi

Cuplikan silikon amorf terhidrogenasi sebelum diimplantasi memiliki hambatan lapis sebesar  $(1,271 \pm 0,004) \times 10^2 \Omega/\square$  dan resistivitas sebesar  $(3,230 \pm 0,010) \times 10^{-1} \Omega\text{-cm}$ .

#### C.2. Pengukuran Hambatan Lapis dan Resistivitas Setelah Implantasi

Energi ion 30 keV

Dosis Ion ( $\times 10^{15} \text{ cm}^{-2}$ )	V/I ( $\times 10^1 \Omega$ )	Hambatan Lapis ( $R_s$ ) ( $\times 10^2 \Omega / \square$ )	Resistivitas ( $\rho$ ) ( $\times 10^{-1} \Omega\text{-cm}$ )
$1,533 \pm 0,030$	$2,163 \pm 0,058$	$0,981 \pm 0,024$	$2,430 \pm 0,060$
$3,141 \pm 0,063$	$1,633 \pm 0,005$	$0,740 \pm 0,002$	$1,990 \pm 0,017$
$6,240 \pm 0,633$	$1,558 \pm 0,003$	$0,719 \pm 0,001$	$1,825 \pm 0,003$
$12,864 \pm 1,307$	$1,468 \pm 0,004$	$0,665 \pm 0,002$	$1,689 \pm 0,004$
$19,203 \pm 1,957$	$1,959 \pm 0,010$	$0,888 \pm 0,004$	$2,250 \pm 0,001$

Energi ion 60 keV

Dosis Ion ( $\times 10^{15} \text{ cm}^{-2}$ )	V/I ( $\times 10^1 \Omega$ )	Hambatan Lapis ( $R_s$ ) ( $\times 10^2 \Omega / \square$ )	Resistivitas ( $\rho$ ) ( $\times 10^{-1} \Omega\text{-cm}$ )
$1,533 \pm 0,155$	$1,707 \pm 0,006$	$0,773 \pm 0,003$	$1,964 \pm 0,006$
$3,153 \pm 0,320$	$1,907 \pm 0,009$	$0,864 \pm 0,004$	$2,197 \pm 0,012$
$6,218 \pm 0,631$	$1,660 \pm 0,009$	$0,752 \pm 0,004$	$1,912 \pm 0,010$
$12,878 \pm 1,308$	$1,489 \pm 0,003$	$0,674 \pm 0,001$	$1,713 \pm 0,003$
$19,095 \pm 1,939$	$1,884 \pm 0,007$	$0,854 \pm 0,003$	$2,170 \pm 0,001$

Dosis ion  $(4,477 \pm 0,228) \times 10^{15} \text{ cm}^{-2}$

Energi Ion (keV)	V/I ( $\times 10^1 \Omega$ )	Hambatan Lapis ( $R_s$ ) ( $\times 10^2 \Omega / \square$ )	Resistivitas ( $\rho$ ) ( $\times 10^{-1} \Omega\text{-cm}$ )
10	$2,330 \pm 0,062$	$1,055 \pm 0,028$	$2,680 \pm 0,072$
20	$1,721 \pm 0,017$	$0,781 \pm 0,008$	$1,984 \pm 0,022$
30	$1,709 \pm 0,011$	$0,775 \pm 0,005$	$1,968 \pm 0,012$
60	$1,509 \pm 0,004$	$0,718 \pm 0,001$	$1,824 \pm 0,003$

### C.3. Pengukuran Hambatan Lapis dan Resistivitas Setelah Proses Anil

Energi ion 30 keV

Dosis Ion ( $\times 10^{15} \text{ cm}^{-2}$ )	V/I ( $\times 10^1 \Omega$ )	Hambatan Lapis ( $R_s$ ) ( $\times 10^2 \Omega / \square$ )	Resistivitas ( $\rho$ ) ( $\times 10^{-1} \Omega\text{-cm}$ )
$1,533 \pm 0,030$	$2,350 \pm 0,069$	$1,066 \pm 0,032$	$2,707 \pm 0,083$
$3,141 \pm 0,063$	$1,509 \pm 0,006$	$0,684 \pm 0,003$	$1,737 \pm 0,007$
$6,240 \pm 0,633$	$1,593 \pm 0,059$	$0,722 \pm 0,027$	$1,834 \pm 0,068$
$12,864 \pm 1,307$	$1,319 \pm 0,006$	$0,598 \pm 0,003$	$1,519 \pm 0,007$
$19,203 \pm 1,957$	$1,478 \pm 0,003$	$0,670 \pm 0,002$	$1,709 \pm 0,004$

### Energi ion 60 keV

Dosis Ion (x10 <sup>15</sup> cm <sup>-2</sup> )	V/I (x10 <sup>1</sup> Ω)	Hambatan Lapis (R <sub>s</sub> ) (x10 <sup>2</sup> Ω / □)	Resistivitas (ρ) (x10 <sup>-1</sup> Ω-cm)
1,533 ± 0,155	1,703 ± 0,003	0,772 ± 0,001	1,960 ± 0,003
3,153 ± 0,320	1,766 ± 0,004	0,800 ± 0,002	2,037 ± 0,003
6,218 ± 0,631	1,569 ± 0,002	0,711 ± 0,001	1,807 ± 0,002
12,878 ± 1,308	1,433 ± 0,003	0,649 ± 0,001	1,649 ± 0,002
19,095 ± 1,939	1,390 ± 0,007	0,630 ± 0,001	1,601 ± 0,004

Dosis ion (4,477 ± 0,228)x10<sup>15</sup> cm<sup>-2</sup>

Energi Ion (keV)	V/I (x10 <sup>1</sup> Ω)	Hambatan Lapis (R <sub>s</sub> ) (x10 <sup>2</sup> Ω / □)	Resistivitas (ρ) (x10 <sup>-1</sup> Ω-cm)
10	1,992 ± 0,009	0,904 ± 0,006	2,297 ± 0,015
20	1,578 ± 0,018	0,720 ± 0,001	1,828 ± 0,003
30	1,477 ± 0,003	0,669 ± 0,001	1,699 ± 0,004
60	1,424 ± 0,001	0,645 ± 0,000	1,639 ± 0,001