

ABSTRACTTIME OF FLIGHT ENERGY MEASUREMENT APPARATUSFOR AN ION BEAM IMPLANTER

In accordance with the present invention, an ion implanter (10) including a time of flight energy measurement apparatus (200) for measuring and controlling the energy of an ion beam (14). The ion implanter (10) includes an ion source (12) for generating the ion beam (14), an ion acceleration assembly (18) for accelerating the beam (14) resulting in the beam (14) comprising a series of ion pulses (P0, P1, ..., P(n+1)) having a predetermined frequency (F) and beam forming and directing structure (50) for directing the ion beam (14) at workpieces (21) supported in an implantation chamber (22) of the implanter (10). The time of flight energy measurement apparatus (200) includes spaced apart first and second sensors (210, 310, 220, 320), timing circuitry (204) and conversion circuitry (206). The time of flight energy measurement apparatus (200) measures an average kinetic energy of an ion (E(ion)) included in a selected ion pulse of the ion beam. The first sensor (210, 310) and a second sensor (220, 320) are disposed adjacent the ion beam (14) and spaced a predetermined distance apart, the second sensor (220, 320) being downstream of the first sensor (210, 310). The first sensor (210, 310) generates a signal when an ion pulse of the ion beam (14) passes the first sensor (210, 310) and the second sensor (220, 320) generates a signal when an ion pulse of the ion beam (14) passes the second sensor (220, 320). The timing circuitry (204) of the energy measurement apparatus (200) is electrically coupled to the first and second sensors (210, 310, 220, 320) and determines an elapsed time, t , for the selected ion pulse to traverse the predetermined distance between the first and second sensors (210, 310, 220, 320). The timing circuitry (204) calculates an average number of ion pulses, N , in the ion beam (14) between the first and second sensors (210, 310, 220, 320) based on the approximation of the ion beam energy (E(approx.)) and calculates an offset time, $t(\text{offset})$, for the selected ion pulse using the formula, $t(\text{offset}) = N \times T$. The timing circuitry (204) then determines the elapsed time, t . The conversion circuitry (206) converts the elapsed time, t , for the selected ion pulse into a measure of the energy of the ion beam (E(ion)).

Figure 3