positioning a plurality of accelerating electrodes along the travel path at spaced apart intervals to define a plurality of accelerating gaps;

applying an alternating accelerating potential of a specific frequency and *controlled* amplitude to each accelerating electrode of the plurality of accelerating electrodes to accelerate the ions in stages through said plurality of accelerating gaps to a second energy;

controlling a relative phase of the electric fields in the accelerating gaps; and

positioning a *semiconductor wafer* workpiece *or a plurality of semiconductor wafer workpieces at an implantation station* so that charged ions accelerated to the second energy impact said *semiconductor wafer* workpiece *or workpieces.*

18. The ion implantation apparatus of claim 1 additionally comprising focusing means for creating a quadrupole field to focus the accelerated ions as they pass through the ion accelerator.

19. The ion implantation apparatus of claim 1 additionally comprising a mass analyzing means for selecting ions having a predetermined charge to mass ratio to an implantation travel path.

20. The ion implantation apparatus of claim 19 wherein the mass analyzing means comprises an analyzing magnet for selecting ions having the initial energy before said ions enter the accelerator.

21. The ion implantation apparatus of claim 20 wherein the analyzing magnet redirects the ions away from their initial travel path to the implantation travel path before the ions reach the accelerator.

22. The ion implantation apparatus of claim 1 wherein the implantation means includes a support for mounting a plurality of said semiconductor wafer workpieces for automated movement through an implant region wherein ions of the second energy impact said workpieces as they move through said implant region.

23. The ion implantation apparatus of claim 1 wherein the energizing means comprises tank circuits that have adjustable components for maintaining resonant frequencies of the tank circuits.

24. The ion implant apparatus of claim 4 additionally comprising focusing means for creating a quadrupole field to focus the accelerated ions as they pass through the ion accelerator.

25. The apparatus of claim 7 wherein the energizing means comprises a plurality of tank circuits having inductive and capacitive components which are tuned to a resonant frequency equal to the specific frequency of the alternating electric field in the acceleration gaps.

26. The apparatus of claim 7 wherein a peak maximum accelerating potential is in a range of from 0–150 k volts and said frequency is in a range of from 3 to 30 megahertz.

27. The apparatus of claim 7 additionally comprising focusing means for creating a quadrupole field to focus the accelerated ions as they pass through the ion accelerator and further wherein a peak maximum accelerating potential is in a range of from 0–150 k volts and said frequency is in a range of from 3 to 30 megahertz.

28. The method of claim 17 wherein at a position before the ions reach the implantation station, ions are mass analyzed to select ions of a specified charge to mass ratio thereby causing the selected ions having said charge to mass ratio to impact the one or more workpieces at the implantation station with said second energy.

29. Ion implantation apparatus comprising:

an ion source for creating ions;

an electrode biased relative to the ion source at an electrostatic potential for directing a beam of the charged ions having an initial energy along a travel path away from the ion source;

means for selecting ions with a desired charge to mass ratio;

an ion accelerator positioned relative the ion source to accelerate ions emitted from the ion source and including a plurality of spaced apart accelerating electrodes which, when energized create an alternating electric field to accelerate the ions entering the ion accelerator with the initial energy in stages through a plurality of accelerating gaps between electrodes to a second energy;

energizing means coupled to the ion accelerator for applying an alternating accelerating potential of a specific frequency and controlled amplitude to each accelerating electrode of the plurality of accelerating electrodes to accelerate the ions through said plurality of accelerating gaps;

automated implantation means for positioning one or more semiconductor wafer workpieces within a process chamber so that charged ions accelerated to the second energy impact said one or more semiconductor wafer workpieces; and

control means coupled to the energizing means to control the relative amplitude and phase of the electric fields in the accelerating gaps.

30. The ion implantation apparatus of claim 29 additionally comprising focusing means for creating a quadrupole field to focus the accelerated ions as they pass through the ion accelerator.

31. The ion implantation apparatus of claim 29 additionally comprising an analyzing means for bending ions having a predetermined charge to mass ratio to an implantation travel path.

32. The apparatus of claim 29 wherein the energizing means comprises a plurality of tank circuits having inductive and capacitive components which are tuned to a resonant frequency equal to the specific frequency of the alternating electric field in the acceleration gaps.

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