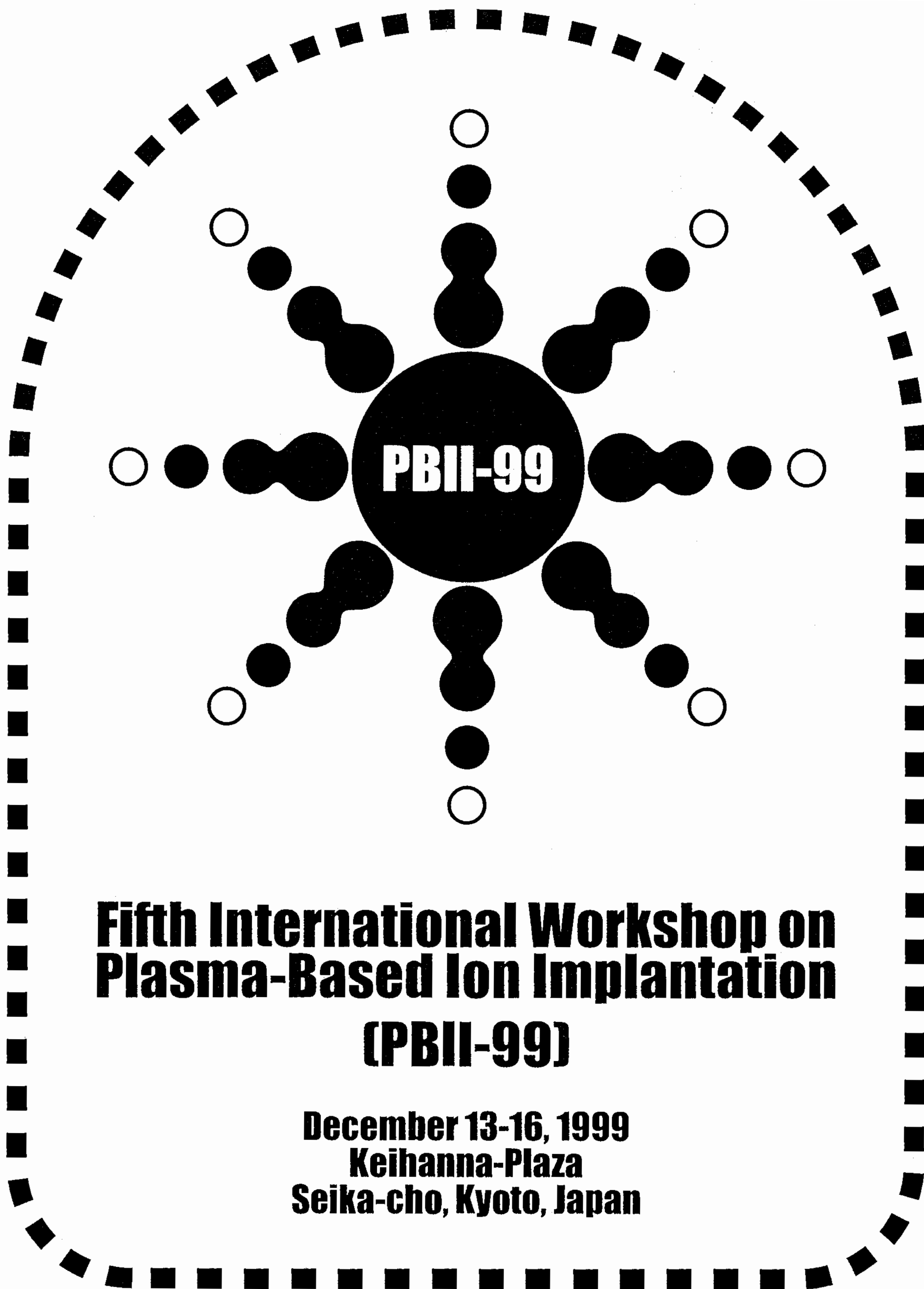

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ABSTRACTS

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Energy distribution and depth profile of BF_3 plasma doping into silicon

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Plasma doping (PD) differs from conventional beam-line implantation doping in several aspects. For instance, in PD, there is no mass filtering and the ion impact angle depends on the target geometry and plasma conditions. There are several ways to alter the impact energy of the incident ions and consequently the dopant depth profile. For example, a BF_3 plasma consists of ion species with different masses, compositions, and charge states. The higher the charge state of the ion, the larger is the impact energy. On the other hand, the net impact energy of B is only 11/49 of the sample bias if BF_2^+ is the dominant species in the plasma. The rise time and fall time of the sample voltage pulse also contribute to the overall energy distribution as a long rise or fall time will increase the low energy component. As a result, the ion energy distribution and depth profile in beam-line implantation and PD are intrinsically different. In this work, one-dimensional particle-in-cell method is employed to simulate BF_3 PD into silicon under typical plasma doping conditions. The energy distributions of the implanted B and F as well as the effects of the rise / fall time and other factors will be discussed. The PD and beam-line depth profiles simulated using TRIM codes will be compared. Our results reveal that the plasma conditions and pulse shape can be altered to obtain the desired B depth profile.