Mechanisms for the Dual ImplantationCleaving Process in Silicon Carbide

J. A. Bennett,[1] L. C. Feldman,[1] O. W. Holland,[2] D. K. Thomas,[2] M. Nastasi[3] and A. Mishra[3]

[1]Vanderbilt University
Dept of Physics and Astronomy
Box 1807-B
Nashville, TN 37235
USA

[2]Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, TN 37831
USA

[3]Los Alamos National Laboratory
MS D-429
Los Alamos, NM 87545
USA

Hydrogen implantation-induced cleaving is successfully used to transfer thin films from single-crystal materials to other substrates. A new dual implantation process, consisting of the usual H+ implant followed by a shallow heavy ion bombardment, significantly enhances the cleaving of SiC over the general H+ implantation-cleaving-bonding process [J.A. Bennett, et al., Appl. Phys. Lett. 76, 3265 (2000)]. The heavy-ion irradiation induces stress in the near surface region, and this stress appears to be a critical factor for enhanced cleaving. In situ stress measurements show that the compressive stress induced during ion bombardment reaches a maximum at about one-third the amorphization threshold dose and then relaxes to a final stress state. This relaxation is attributed in part to the formation of misfit dislocations in the H+-implanted layer. These dislocations are believed to aid fracture along the cleavage plane thereby enhancing exfoliation.