On the reconstruction of defect depth profiles obtained from the positron annihilation experiment and chemical etching

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It is generally accepted that the positron beam technique allows to distinguish information about the depth distribution of defects or positron traps, which is extended below the entrance surface. However, the depth range of the examined defect distribution is limited to the depth of implanted positrons, which is about 1-2 micrometers. In turn, an experimental technique based on sequential etching of the tested sample does not have such a limitation and allows to recognize the distribution to a depth of about one hundred micrometres or more. In this case, conventional positron techniques based on ^{22}Na positrons are used, but we should stress that this is a destructive technique. Recently, this technique has been successfully used to study defects induced by implantation of heavy ions to a depth of approximately 10 µm. This encourages us to try to reproduce the distribution of real depths, e.g. the average lifetime of positrons in the samples tested. Mathematical considerations have allowed us to find useful relationships that can be used to recognize the actual distribution of the mean positron lifetime or shape of annihilation line, i.e., S-parameter, and thus to deduce the depth distribution of defects using the measured values. Our recent studies of pure Bi or Si implanted with Xe^{26+} illustrate the use of these relationships [1]. The main conclusion is that the defect concentration remains almost constant throughout the implanted layer, which is contrary to the theoretical predictions of the SRIM code. This suggests that not only nuclear collisions of implanted ions are responsible for the generation of defects, but also other processes.

References

[1] J. Dryzek, K. Siemek, Appl. Phys. A, **125** (2019) 85-10.

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