REVIEW ON THE BOOK

Nuclear Doping of Semiconductor Materials (second edition, revised)

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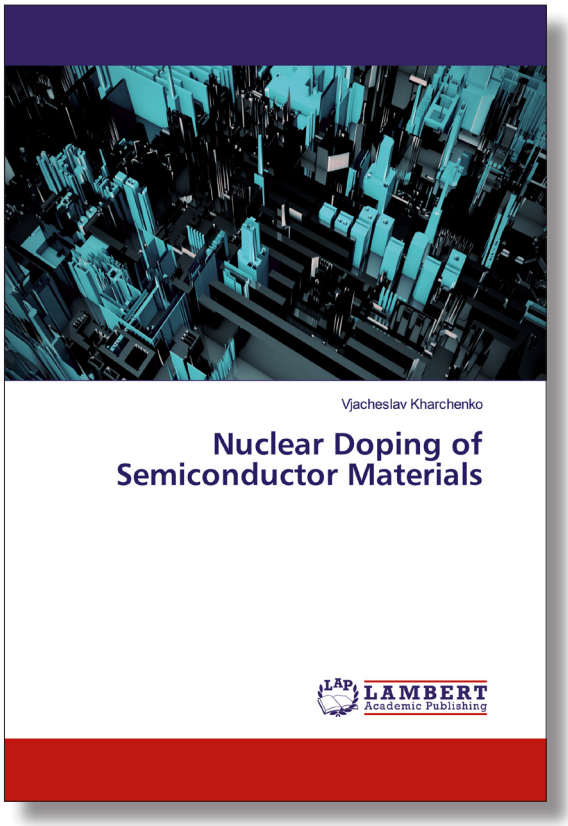

The discovery of nuclear reactions has led to the ultimate dream come true of alchemists – the transformation of elements, but, as it is always the case, not exactly the way they have hoped it to be. Indeed, the production of radioactive isotopes has become a profitable branch of industry, but obtaining gold through nuclear transformations has proven to be too expensive — much more expensive than gold itself. This is what we know well since schooldays. However, producing isotopes inside solid bodies is a completely different task. The possibility of producing technologically important impurities in semiconductors through matrix element transmutation reactions was first reported by Lark-Horowitz in 1951 [1]. However this possibility would have remained just a curios fact in the history of science had it not been for a special circumstance: whereas impurity atoms exhibit the tendency of clustering during crystal growth from melt, isotopes of matrix elements do not. Indeed, Si30 transmutation (the natural abundance of this isotope 3.05%) to P31 as a result of thermal neutron trapping has allowed obtaining n-type silicon with an unparalleled homogeneity of phosphorus doping which is the key requirement in a wide range of important applications. However, as it always turns out to be, the road from the birth of the idea to its practical implementation was thorny. The resultant material should not be radioactive. One should eliminate without a trace any structural defects which are an inevitable collateral effect of neutron irradiation. The electrical and recombination parameters of transmutation doped semiconductors should comply with the highest industry standards, and, last but not least, the technology should be economically viable. All these tasks have been solved by means of neutron transmutation doping of silicon. Naturally, neutron transmutation doping of other semiconductors has also been investigated, as well as potential usage of irradiation with gamma quanta, high-energy protons and alpha particles in transmutation doping reactions, but these efforts have not yielded any practically valuable results, at least as yet.

These and many other aspects of semiconductors doping through nuclear reactions were discussed in detail in the first edition of the book written by L.S. Smirnov, S.P. Solov'ev, V.F. Stas' and V.A. Kharchenko [2]. The book was published in 1981 and has become a rare book since long. Therefore the second expanded and enlarged edition prepared by V.A. Kharchenko, an internationally renowned pioneer in neutron transmutation doping of semiconductors [3], is quite a timely publication which will doubtlessly find a wide audience of interested readers among physicists and engineers in semiconductors science and technology.

References

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