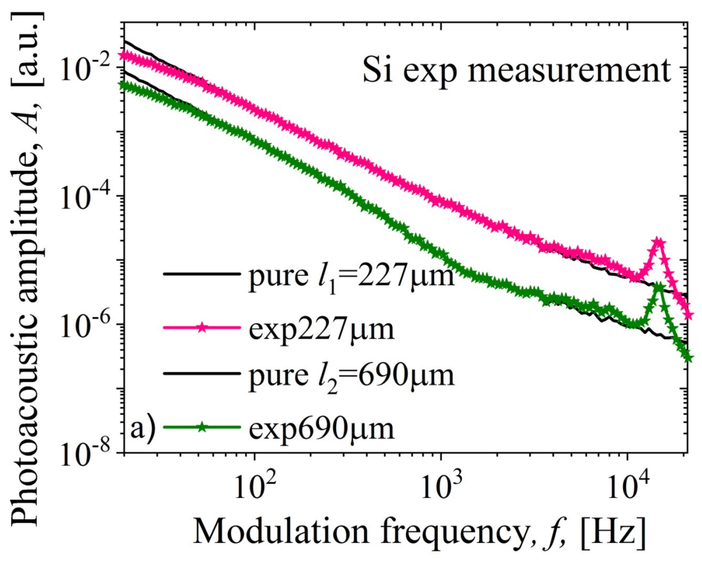
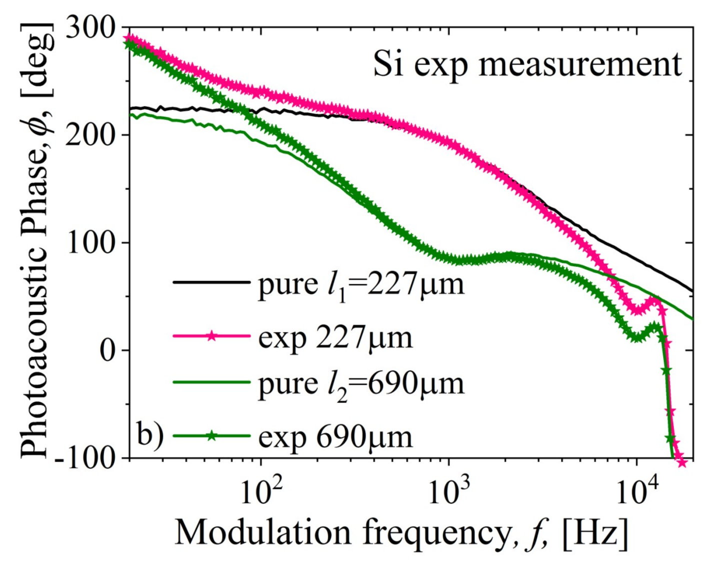
Electronic Semiconductor Characterization Using Reverse-Back Procedure Based on Neural Networks and Photoacoustic Response

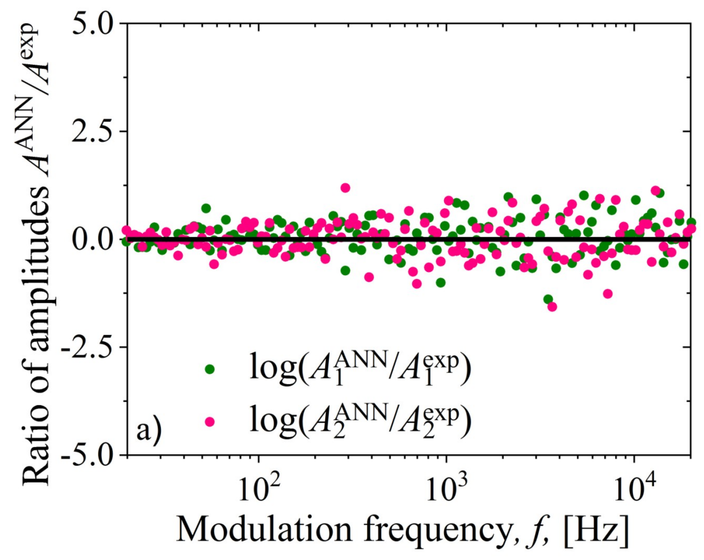
K.Lj. Djordjević[1], S.P. Galović[1], Ž.M. Ćojbašić[2], D.D. Markushev[3], D.K. Markushev[4], S.M. Aleksić[4], D.S. Pantić[4]

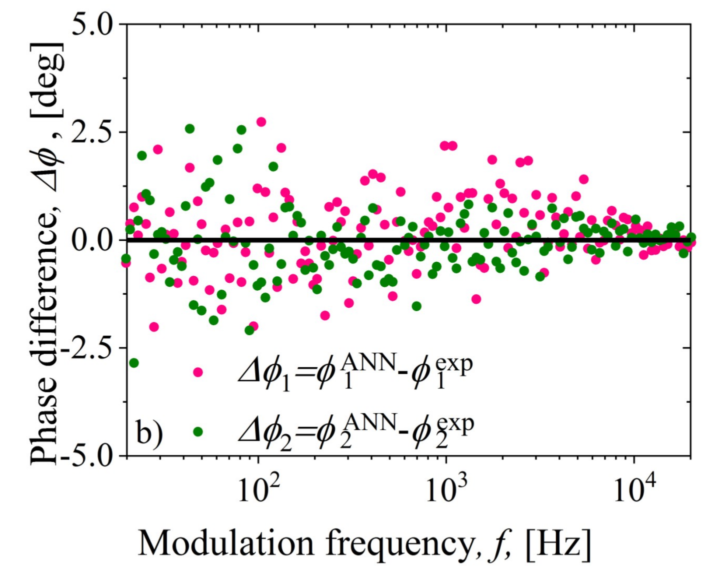
[1]*University of Belgrade, „VINČA" Institute of Nuclear Sciences - National Institute of the Republic of Serbia, PO box 522, 11000 Belgrade, Serbia*
[2]*University of Niš, Mechanical Engineering Faculty, Aleksandra Medvedeva 14, 18000 Niš, Serbia*
[3]*University of Belgrade, Institute of Physics Belgrade, National Institute of the Republic of Serbia, Pregrevica 118, 11080 Belgrade (Zemun), Serbia*
[4]*University of Niš, Faculty of Electronic Engineering, Aleksandra Medvedeva 14, 18000 Niš, Serbia*

Katarina Djordjevic e-mail: katarinaljdjordjevic@gmail.com









Abstract

In this paper, electronic semiconductor characterization using reverse-back procedure was applied to different photoacoustic (PA) responses aiming to find effective ambipolar diffusion coefficient and a bulk life-time of the minority carriers. The main idea was to find the small fluctuations in investigated parameters due to detecting possible unwanted sample contaminations and temperature variations during the measurements. The mentioned procedure was based on the application of neural networks [1]. Knowing that in experiments the contaminated surfaces of the sample can play a significant role in the global recombination process that we are measuring and that the unintentionally introduced defects of the sample crystal lattice could vary the carrier lifetime by several orders of magnitude, a method of PA signal adjustment by the reverse-back procedure is developed, based on the changes of the carrier electronic parameters. Such changes are detected and calculated here by analyzing PA signal amplitude ratios A^{ANN} / A^{exp} and phase differences $\phi^{ANN} - \phi^{exp}$ obtained using experimental (exp) and network predicted (ANN) thermal and geometrical parameters of the sample [2]. The values of photogenerated carrier lifetime and ambipolar diffusion coefficient obtained by the presented method can be used in the quality control procedure of the investigated samples, active control of the experimental conditions and within the general characterization process of semiconductors.

REFERENCES

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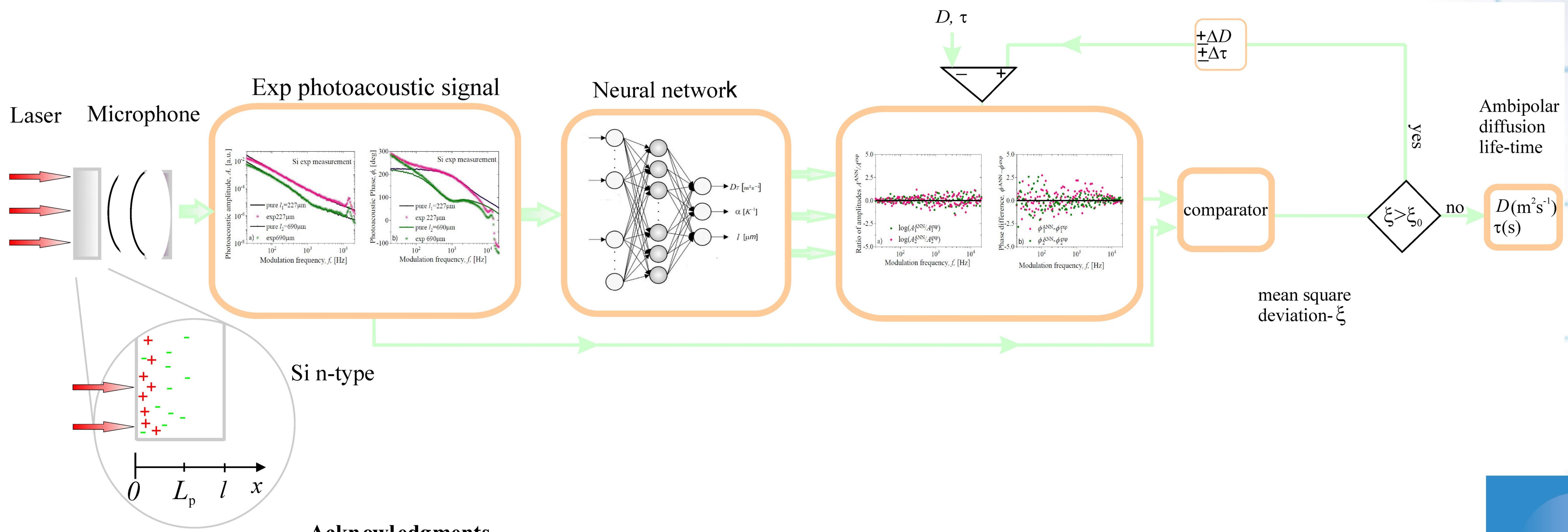
	Sample no. 1			Sample no.2		
parameters	D_T^{ANN}	α_T^{ANN}	l^{ANN}	D_T^{ANN}	α_T^{ANN}	l^{ANN}
unit	$[10^{-5}m^2s^{-1}]$	$[10^{-6}K^{-1}]$	$[10^2\mu m]$	$[10^{-5}m^2s^{-1}]$	$[10^{-6}K^{-1}]$	$[10^2\mu m]$
Corrected PA	9.0000	2.6000	2.27	9.0000	2.6000	6.90
ANN predict	8.9823	2.6246	2.2804	9.0492	2.5831	6.8918
rel % error	0.1967	0.9462	0.4881	0.5467	0.6500	0.1188

	Sample no.1	Sample no.2
D_p^{RBP} $[10^{-3}m^2s^{-1}]$	1.20999	1.19511
relative % error	0.83250	0.40750
τ_p^{RBP} $[10^{-6}s]$	5.05599	4.99911
relative % error	1.11980	0.01780
L_p^{RBP} $[10^{-5}m]$	7.82157	7.72948
relative % error	0.97561	0.21327



Acknowledgments

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