

**Списък на публикациите
на доц. дфзн Веселин Тодоров Дончев**

O. Chapters in books

A. Articles in scientific journals

B. Conference papers published in scientific journals

C. Papers published in conference proceedings

D. Textbooks

E. Papers in popular journals and collections

U. Unpublished reports

O. Chapters in books

- O.1. **V. Donchev**, K. Germanova, N. Shtinkov, S. J. Vlaev
"Electronic structure and optical properties of AlAs/GaAs superlattices containing embedded GaAs quantum wells with abrupt and graded interfaces"
in: *Frontal Semiconductor Research*, ed. Oliver T. Chang (Nova Science Publishers, Inc. New York, 2006)
Chap. 2, pp.25-60.
- O.2. V. Donchev, M. Milanova, S. Georgiev, book chapter "Study of GaAs-Based Dilute Nitride Materials Grown by Liquid Phase Epitaxy" in: *Newest Updates in Physical Science Research* (B. P. International, 2021) Vol. 7, 31–38.

A. Articles in scientific journals

- A1. **V. Donchev**, K. Nanev, Chr. Tenchov
"On the interpretation of the titanium line in the appearance potential spectroscopy"
Vacuum **36**, 655-657 (1986).
- A2. K. Germanova, **V. Donchev**, Ch. Hardalov, L. Nikolov
"EL2 in photoconductivity spectra of Cr-doped SI GaAs bulk crystals"
J. Phys. D: Appl. Phys. **20**, 1507 (1987).
- A3. K. Germanova, **V. Donchev**, L. Nikolov
"Analysis of surface conductance in semiinsulating gallium arsenide containing deep levels in the bulk"
Bulg. J. Phys. **15**, 575 (1988).
- A4. K. Nanev, **V. Donchev**
"On the shape of the Ti L₃ -line"
Comptes rendus de l'Académie bulgare des Sciences **42**, 43 (1989)
- A5. K. Germanova, **V. Donchev**, V. Valchev, Ch. Hardalov
"Characterisation of medium-doped n-type GaAs by Hall measurements"
Phys. Status Solidi (a) **113**, K231 (1989).
- A6. K. Germanova, **V. Donchev**, V. Valchev, Ch. Hardalov, I. Yanchev
"On the maximum in Hall coefficient temperature dependence in medium-doped n-GaAs"
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- A7. **V. Donchev**, K. Germanova
 "Macroscopic Topographic Investigations of Near-Infrared Optical Absorption and Photoconductivity in Chromium Doped Semi-insulating GaAs wafers"
 Bulg.J.Phys. **18**, No 1, 29 (1991).
- A8. **M. Zazoui, V. Donchev, J.C. Bourgoin**
 "Electron emission from defects in multiband semiconductors"
 Phys.Rev.B. **47** (8), 4296-4300 (1993)
- A9. **S.L.Feng, J.Krynicky, V. Donchev, J.C.Bourgoin, M.Di Forte-Poisson, C.Brylinski, S.Delage, H.Blank, S.Alaya.**
 "Band Offset of GaAs-GaInP Heterojunctions"
 Semicond. Sci. Technol. **8**, 2092 (1993)
- A10. **H.Chaabane, M.Zazoui, J.C.Bourgoin, V. Donchev.**
 "Electronic Transport through Semiconductor Barriers"
 Semicond. Sci. Technol. **8**, 2077 (1993)
- A11. **K.Germanova, V. Donchev, I. Ivanov, N.Zheleva, Ch. Hardalov**
 "Spectral Behaviour of Zero-bias Photocurrent at Low-Temperature in Bulk Semi-Insulating GaAs."
 J.Electrochem.Soc.**141** (9), 2533 (1994)
- A12. **V. Donchev, K.Germanova**
 "Time evolution of Zero-Bias photocurrent in semiinsulating GaAs:Cr"
 J.Material Science Letters **15** (23), 2075 (1996)
- A13. **V. Donchev, N.Shtinkov, K.Germanova,**
 "Effect of random defect density fluctuations on the Fermi level in highly compensated semiconductors"
 Mat. Sci. & Engineering B: Solid State Materials for Advanced Technology **47**, 131-136 (1997)
- A14. **N.Shtinkov, V. Donchev, K.Germanova, H.Kolev**
 "Electronic Structure of Quantum Wells Embedded in Short-Period Superlattices with Graded Interfaces"
 Semicond. Sci. Technol. **15**, 946-949 (2000)
- A15. **N. Shtinkov, S.J. Vlaev, V. Donchev**
 "Γ-X Coupling in Diffused AlAs/GaAs Superlattices"
 phys. stat. sol. (b) **221** (2), R9-R10 (2000).
- A16. **M. Mazilu, A. Miller, V. T. Donchev**
 "Modular Method for Calculation of Transmission and Reflection in Multilayered Structures"
 Applied Optics **40**, 6670-6676 (2001).
- A17. **V. Donchev, J. C. Bourgoin, P. Bois**
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 Semicond. Sc. Technol. **17** (6) 621-624 (2002).
- A18. **V. Donchev, K.Germanova, M.Saraydarov, K.Dachev**
 "Kinetics study on the mechanism of zero-bias photocurrent in semi-insulating bulk GaAs"
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- A19. **V. Donchev, J. C. Bourgoin, P. Bois**
 "Dark current in electron irradiated GaAs/AlGaAs multiple quantum wells"
 Nucl. Instrum. Methods in Phys. Res. A **517** (1-3), 94-100 (2004).
- A20. **E.S.Moskalenko, V. Donchev, K.F.Karlsson, P.O.Holtz, B.Monemar, W.V.Schoenfeld, J.M.Garcia and P.M.Petroff**
 "Effect of an additional infrared excitation on the luminescence efficiency of a single InAs/GaAs quantum dot"
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- A21. M. Saraydarov, **V. Donchev**, K. Germanova, X. L. Wang, S. J. Kim, M. Ogura
 "Characterization of GaAs/AlGaAs quantum wires by means of longitudinal photoconductivity"
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- A22. E. S. Moskalenko, K. F. Karlsson, **V. Donchev**, P. O. Holtz, B. Monemar, W. V. Schoenfeld, P.M.Petroff
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- A23. E. S. Moskalenko, K. F. Karlsson, **V. Donchev**, P. O. Holtz, B. Monemar, W. V. Schoenfeld, P.M.Petroff
 "Effective optical manipulation of the charge state and emission intensity of the InAs/GaAs quantum dots by means of additional infrared illumination"
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- A24. K. Germanova, **V. Donchev**, N. Shtinkov, S. Vlaev
 "Electronic properties of AlAs/GaAs superlattices containing embedded GaAs quantum wells"
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- A25. **V. Donchev**, K. Germanova, N. Shtinkov
 "Optical properties and interface quality of GaAs quantum wells embedded in short-period AlAs/GaAs superlattices"
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- A26. E.S. Moskalenko, K.F. Karlsson, **V. Donchev**, P.O. Holtz, B. Monemar, W.V. Schoenfeld, P.M. Petroff
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- A27. Evgenii S. Moskalenko, Fredrik K. Karlsson, **Vesselin T. Donchev**, Per Olof Holtz, Bo Monemar, Winston V. Schoenfeld, and Pierre M. Petroff
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- A28. **V. Donchev**, E.S. Moskalenko, K.F. Karlsson, P.O. Holtz, B. Monemar, W.V. Schoenfeld, J.M.Garcia, P.M. Petroff
 "Enhancement of the photoluminescence intensity of a single InAs/GaAs quantum dot by separate generation of electrons and holes"
 Physics of the Solid State **48** (10) 1993-1999 (2006), Translation from Fizika Tverdogo Tela **48** (10) 1877-1879 (2006).
- A29. **V. Donchev**, K. Kirilov, Ts. Ivanov, K. Germanova
 "Surface photovoltage phase spectroscopy– a handy tool for characterisation of bulk semiconductors and nanostructures"
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- A30. Ts. Ivanov, **V. Donchev**, Y. Wang, H. S. Djie, and B. S. Ooi
 "Interdiffused InAs/InGaAlAs quantum dashes-in-well structures studied by surface photovoltage spectroscopy"
 J. Appl. Phys. **101** (11) 114309 (2007)
- A31. **V. Donchev**, K. Kirilov, Ts. Ivanov, K. Germanova
 A surface photovoltage spectroscopy study of GaAs/AlAs complicated nanostructures with graded interfaces
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- A32. Ts. Ivanov, **V. Donchev**, K. Germanova and K. Kirilov
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- A33. **V. Donchev**, Ts. Ivanov, K. Germanova, K. Kirilov
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 Trends in Applied spectroscopy **8**, 27- 66 (2010)

- A34. F. Iikawa, **V. Donchev**, Ts. Ivanov, G. O. Dias, L. H. G. Tizei, R. Lang, E. Heredia, P. F. Gomes, M. J. S. P. Brasil, M. A. Cotta, D. Ugarte, J. P. Martinez Pastor, M. M. de Lima Jr., and A. Cantarero
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Nanotechnology **22**, 065703 (2011).
- A35. Ts. Ivanov, **V. Donchev**, K. Germanova, P. F. Gomes, F. Iikawa, M. J. S. P. Brasil and M. A. Cotta
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- A36. **V. Donchev**, D. Nesheva, D. Todorova, K. Germanova, E. Valcheva
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Thin Solid Films **520** (6) 2085–2091 (2012)
- A37. T. Angelova, N. Shtinkov, Ts. Ivanov, **V. Donchev**, A. Cantarero, Ch. Deneke, O. G. Schmidt, and A. Cros
 “Optical and acoustic phonon modes in strained InGaAs/GaAs rolled up tubes”
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- A38. **V. Donchev**, Ts. Ivanov, Ts. Ivanova, S. Mathews, J. O. Kim² and S. Krishna
 “Surface photovoltage spectroscopy study of InAs quantum dot in quantum well multilayer structures for infrared photodetectors”
Superlattices and Microstructures **88**, 711–722 (2015)
- A39. M. Milanova, **V. Donchev**, K. Kostov, D. Alonso-Álvarez, E. Valcheva, K. Kirilov, I. Asenova, I. G. Ivanov, S. Georgiev and N. Ekins-Daukes
 „Experimental study of the effect of local atomic ordering on the energy band gap of melt grown InGaAsN alloys“
Semicond. Sci, Technol **32** (8) 085005 (2017)
- A40. **V. Donchev**, M. Milanova, I. Asenova, N. Shtinkov, D. Alonso-Álvarez, A. Mellor, Y. Karmakov, S. Georgiev and N. Ekins-Daukes
 „Effect of Sb in thick InGaAsSbN layers grown by liquid phase epitaxy“
J. Cryst. Growth **483** 140–146 (2018)
- A41. **V. Donchev**, S. Georgiev, I. Leontis and A. G. Nassiopoulou
 „Effective Removal of Surface Recombination Centers in Silicon Nanowires Fabricated by Metal-Assisted Chemical Etching“
ACS Appl. Energy Mater. **1** (8) 3693–3701 (2018)
- A42. Tareq Abu Hamed,, **V. Donchev**, et al.
 „Multiscale in modelling and validation for solar photovoltaics“
EPJ Photovoltaics **9**, 10 (2018)
- A43. M. Milanova, **V. Donchev**, K. L. Kostov, D. Alonso-Álvarez, P. Terziyska, G. Avdeev, E. Valcheva, K. Kirilov and S. Georgiev
 „Study of GaAsSb:N bulk layers grown by liquid phase epitaxy for solar cells applications“
Mat. Res.Express **6** (7) 075521 (2019)
- A44. **V. Donchev**
 „Surface photovoltage spectroscopy of semiconductor materials for optoelectronic applications“
Mater. Res. Express **6** 103001 (2019), DOI: <https://doi.org/10.1088/2053-1591/ab3bf0>
 ISSN: 2053-159, IF(2019) 1.929
- A45. M. Milanova, **V. Donchev**, B. Arnaudov, D. Alonso-Álvarez, P. Terziyska
 „GaAsSbN-based p-i-n heterostructures for solar cell applications grown by liquid-phase epitaxy“
J. Mat. Sci.:Materials in Electronics **31** (3), 2073–2080 (2020) DOI 10.1007/s10854-019-02728-5

- A46. M. Milanova, **V. Donchev**, K. J. Cheetham, Zh. Cao, I. Sandall, G. M. Piana, O. S. Hutter, K. Durose, A. Mumtaz
 „Single-junction solar cells based on p-i-n GaAsSbN heterostructures grown by liquid phase epitaxy“
Solar energy **208**, 659-664 (2020)
- A47. **V. Donchev**, M. Milanova, K. Kirilov, S. Georgiev, K.L. Kostov, G.M. Piana, G. Avdeev,
 „Low-temperature LPE growth and characterization of GaAsSb layers for photovoltaic applications“
Journal of Crystal Growth, **574**, 126335, (2021)
- A48. Aleksandra BOJAR, Davide Regaldo, José Alvarez, David Alamarguy, **Vesselin Donchev**, Stefan Georgiev,
 Philip Schulz and Jean-Paul Kleider
 „Surface photovoltage characterisation of metal halide perovskite on crystalline silicon using Kelvin probe
 force microscopy and metal-insulator-semiconductor configuration“
EPJ Photovoltaics **13**, 18 (2022) <https://doi.org/10.1051/epjpv/2022016>
- A49. Vesselin Donchev, Malina Milanova, Stefan Georgiev
 „Surface Photovoltage Study of GaAsSbN and GaAsSb Layers Grown by LPE for Solar Cells Applications“
Energies **15** (18) 6563 (2022) <https://doi.org/10.3390/en15186563>
- A50. **Vesselin Donchev**, Davide Regaldo, Stefan Georgiev, Aleksandra Bojar, Mattia da Lisca, Kiril Kirilov, José
 Alvarez, Philip Schulz, and Jean-Paul Kleider
 „Surface Photovoltage Study of Metal Halide Perovskites Deposited Directly on Crystalline Silicon“
ACS Omega **8** (9) 8125–8133 (2023) doi: 10.1021/acsomega.2c07664

B. Conference papers published in scientific journals

- B1. M.Mazilu, **V. Donchev**, A.Miller, O.Blum
 “Optical determination of interface roughness in multilayered semiconductor structures”
Appl.Phys.B **68**, 633-636 (1999)
 (poster presented at Int. Conf. Nonlinear Optics at Interfaces, 21-24.09.1998, Berlin, Germany)
- B2. **V. Donchev**, K.Germanova, N.Shtinkov, I.Ivanov, S.Vlaev
 “Photoluminescence Study of AlAs/GaAs Superlattices Containing Enlarged Wells”
Thin Solid Films **364**, 224-227 (2000)
 (poster presented at E-MRS 1999, Symposium P, 1-4 June, 1999, Strasburg, France)
- B3. N.Shtinkov, S.Vlaev, **V.Donchev**, K.Germanova
 “Electronic States of a Superlattice with an Enlarged Quantum Well: A Tight-Binding Approach”
Physica Status Solidi (b) **220** (1) 153-157 (2000)
 (paper presented at the Latin American Symposium on Solid State Physics, 1-6.11.1999, Cartagena de Indias,
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- B4. **V.Donchev**, Tzv. Ivanov, I.Ivanov, M.Angelov, K.Germanova
 “High Temperature Excitons in GaAs Quantum Wells Embedded in AlAs/GaAs Superlattices
Vacuum **58**, 478-484 (2000)
 (poster presented at VEIT-99, September, 1999, Varna, Bulgaria)
- B5. N.Shtinkov, **V.Donchev**, K.Germanova, S.Vlaev, I.Ivanov
 “Effect of non-abrupt interfaces in AlAs/GaAs Superlattices with Embedded GaAs Quantum Wells”
Vacuum **58**, 561-567 (2000)
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- B6. **V.Donchev**, N.Shtinkov, K.Germanova, I.Ivanov, H.Brachkov, Tzv.Ivanov
 “Photoluminescence Line-Shape Analysis in Quantum Wells Embedded in Superlattices”
Mat. Sci. Engin. C **15**, (1-2) 75-77 (2001).
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- B7. J.C. Bourgoin, J.-Ph. Montagne, **V. Donchev**
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 Bulg. J. Phys. **27** (1), 65-70 (2000)
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- B8. **V. Donchev**, M. Saraydarov, N. Shtinkov, S. Vlaev
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- B9. **V. Donchev**, K. Germanova, N. Shtinkov, H. Brachkov and I. Ivanov
 “Exciton Dominated High-Temperature Photoluminescence in Quantum Wells embedded in Superlattices”
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- B10. N. Shtinkov, S. Vlaev, **V. Donchev**
 “Interdiffusion-induced direct to indirect transition in AlAs/GaAs superlattices”
 Balkan Phys. Lett. **9**, 101-105 (2001).
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- B11. **V. Donchev**, M. Saraydarov, N. Shtinkov, K. Germanova, S.J. Vlaev
 “Diffused GaAs/AlGaAs quantum wells with equidistant electronic states”
 Mat. Sci. Engin. C **19** (1-2), 135-138 (2002).
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- B12. H. Samic, G. C. Sun, **V. Donchev**, N. X. Nghia, M. Gandouzi, M. Zazoui, J. C. Bourgoin, H. El-Abbassi, S. Rath, P. J. Sellin
 “Characterization of Thick Epitaxial GaAs Layers for X-ray Detection”
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- B13. M. Saraydarov, **V. Donchev**, K. Kirilov, K. Germanova
 ”An alternative approach to electronic structure calculation of crescent-shaped GaAs/AlGaAs quantum wires”
 Journal of Materials Science: Materials in Electronics **14**, 795-796 (2003)
 (poster at the 12th Int. School on Condensed Mater Phys., 1-6.09.2002, Varna, Bulgaria)
- B14. **V. Donchev**, M. Saraydarov, K. Germanova, M. Ivanov
 “Longitudinal photoconductivity of GaAs/AlGaAs quantum wires”
 Journal of Materials Science: Materials in Electronics **14**, 793-794 (2003)
 (poster at the 12th Int. School on Condensed Mater Phys., 1-6.09.2002, Varna, Bulgaria)
- B15. **V. Donchev**, K. F. Karlsson, E. S. Moskalenko, P. O. Holtz, B. Monemar, W. V. Schoenfeld, J. M. Garcia, and P. M. Petroff
 “Temperature study of the photoluminescence of a single InAs/GaAs quantum dot”
 phys. stat. sol. (c) **1** (3), 608-611 (2004)
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- B16. K. Kirilov, K. Germanova, **V. Donchev** and Tzv. Ivanov
 ”Numerical simulation of time-resolved surface photovoltage at SI-SiO₂ interfaces”
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 (poster at the 13th ISCMP, 30.08-03.09. 2004, Varna, Bulgaria)
- B17. M. Saraydarov, **V. Donchev**, K. Germanova and K. Kirilov
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 J. Optoe. & Adv. Mat. **7** (1) 525-528 (2005)
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- B18. K. Kirilov, **V. Donchev**, Tsv. Ivanov, K. Germanova, P. Vitanov and P. Ivanov
 ”A surface photovoltage spectroscopy system used for minority carrier diffusion length measurements on floating zone silicon”
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 "Surface Photovoltage Spectroscopy of GaAs Quantum Wells Embedded in AlAs/GaAs Superlattices"
 Bulg. J. Phys. **33** (3) 217-222 (2006) - Proc. Alexander von Humboldt Conf. "Advances in Physics and Astrophysics of the 21st Century", 6–11.09.2005, Varna, Bulgaria, Ed. I. Zhelyazkov, (Heron Press, Sofia, 2006).
- B20. K. Kirilov, Ts. Ivanov, **V. Donchev**, K. Germanova
 "An Alternative Approach For Determining The Semiconductor Type Based on SPV Phase Spectral Measurements"
 Bulg. J. Phys. **33** (3) 223-228 (2006) - Proc. Alexander von Humboldt Conf. "Advances in Physics and Astrophysics of the 21st Century", 6–11.09.2005, Varna, Bulgaria, Ed. I. Zhelyazkov, (Heron Press, Sofia, 2006).
- B21. **V. Donchev**, Ts. Ivanov, Y. Wang, H. S. Djie, B. S. Ooi
 "Surface photovoltage spectroscopy of interdiffused InAs/InGaAlAs quantum dashes-in-well structure"
 phys. stat. sol. (c) **4** (2) 412–414 (2007)
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- B22. K. Kirilov, **V. Donchev**, M. Saraydarov, K. Germanova
 "Electron states energies and wave functions of V-shaped quantum wires with graded interfaces"
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- B23. Ts. Ivanov, **V. Donchev**, K. Kirilov, K. Germanova
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 J. Optoe. & Adv. Mat. **9** (1) 190-193 (2007).
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- B24. S. Dimitrov, E. Valcheva, **V. Donchev**
 "Electronic states properties in GaN/Al_xGa_{1-x}N heterostructures with graded interfaces"
 J. Optoe. & Adv. Mat. **9** (1) 194-196 (2007)
 (poster at the 14th ISCMP, 17-22.09. 2006, Varna, Bulgaria)
- B25. A. M. Miteva, S. J. Vlaev, **V.T. Donchev**, L. M. Gaggero-Sager
 "Quantum confined Stark effect in n-type delta-doped quantum wells "
 Revista Mexicana de Fisica **S53** (7), 74-77 (2007)
 (oral presentation on the Latin American Symposium of Solid State Physics, 20-24. 11.2006, Puebla, Mexico)
- B26. A. M. Miteva, S. J. Vlaev, and **V. Donchev**
 "Stark effect in p-type delta doped quantum wells"
 Progress In Electromagnetics Research Letters, **2**, 45-52 (2008).
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- B27. Ts Ivanov, **V. Donchev**, K Bachev, Y-H Ding, Y Wang, H S Djie and B S Ooi
 "Bandgap engineering of InAs/InGaAlAs quantum dashes-in-well laser structures: A surface photovoltage spectroscopy study"
 J. Phys. : Conf. Ser. **113**, 012033 (2008)
 (poster presented at VEIT-2007, September, 2007, Varna, Bulgaria)
- B28. D. Todorova, E. Valcheva, **V. Donchev**, D. Manova, S. Mändl
 "Optical properties of AlN/SiO₂ nanocomposite layers"
 J. Optoe. & Adv. Mat. **11** (9) 1296 - 1298 (2009)
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- B29. **V Donchev**, Ts Ivanov, T Angelova, A Cros, A Cantarero, N Shtinkov, K Borisov, D Fuster, Y González and L González
 "Surface photovoltage and photoluminescence spectroscopy of self-assembled InAs/InP quantum wires"
 J. Phys. : Conf. Ser. **210** 012041(2010)
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- B30. Ts Ivanov, **V Donchev**, T Angelova, A Cros, A Cantarero, N Shtinkov, K Borissov, D Fuster, Y González and L González
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- B31. Ts. Ivanov, **V. Donchev**, K. Germanova, Ts. Tellaleva, K. Borissov, V. Hongpinyo, P. Vines, J. P. R. David, and B. S. Ooi
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 J.Phys.:Conf. Ser. **356**, 012032 (2012)
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- B32. **V Donchev**, M Milanova, J Lemieux, N Shtinkov and I G Ivanov
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 J. Phys.: Conf. Ser. **700** (1) 012028 (2016)
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- U11. **V Donchev**, Ts Ivanov, T Angelova, A Cros, A Cantarero, N Shtinkov, K Borisov, Ts. Tellaleva, D Fuster, Y González and L González
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- U12. **V Donchev**
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 seminar at the Faculty of Physics, University of Valencia, Spain (June, 2009).
- U13. **V. Donchev**
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- U14. **V Donchev**, I Asenova, M Milanova, D Alonso-Álvarez, K Kirilov, N Shtinkov, I G Ivanov, S Georgiev, E Valcheva and N Ekins-Daukes
 „Characterization of liquid-phase epitaxy grown thick GaInAs (Sb)N layers“
 (poster at PHOTONICA2017 The 6th International School and Conference on Photonics, 28.08.-01.09.2017 Belgrade, Serbia)
- U15. **V.Donchev**
 „Surface Photovoltage Spectroscopy Studies of Optoelectronic Materials and Nanostructures“
 invited lecturer, 11th Photonic Workshop, 11-14.03.2018, Kopaonik, Serbia
- U16. M. Milanova, **V. Donchev**, K. Kirilov, D. Alonso-Álvarez, M. Guina, A. Aho, B. Arnaudov, S. Georgiev, N.

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(Poster at 34th Int. Conf. of Physics of Semiconductors, 29.07-03.08.2018, Montpellier, France)

U17. V. Donchev

“Investigation of dilute nitrides bulk layers and heterostructures grown by LPE for solar cells applications”
lecture at the 2nd workshop “Advanced Materials for the Efficient use of Energy” 28-29.10.2019, Valencia, Spain

U18. V. Donchev

"Surface Photovoltage Spectroscopy of Optoelectronic Materials"
lecture at GeePs, CNRS - CentraleSupélec - Université Paris Saclay, Oct.,2021)

U19. V. Donchev

"Surface Photovoltage Spectroscopy -Physics and Applications"
lecture at Insitute Photovoltaic de France, Paris, Oct.,2021)