

Raman scattering of light by silicon single crystals doped with chromium atoms

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This paper presents the experimental results of a study of single-crystal Si (111) doped with chromium. The studies were carried out using the method of Raman spectroscopy (Raman spectroscopy). It has been found that the doping of transition elements with pure silicon leads to a decrease in the intensity of the Raman peaks by several times, as well as to the formation of additional peaks in the spectra.

Keywords: Raman scattering, silicon, chromium, diffusion.

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REFERENCES

1. Kh. S. Daliev, Sh. B. Utamuradova, O. A. Bozorova, and Sh. Kh. Daliev, *Applied Solar Energy* (English translation of *Geliotekhnika*) **41** (1), 80 (2005).
2. K. P. Abdurakhmanov, Sh. B. Utamuradova, Kh. S. Daliev, S. G. Tadjy-Aglava, and R. M. Ergashev, *Semiconductors* **32** (6), 606 (1998).
3. T. Kamiya, M. Kishi, A. Ushirokawa, and T. Katoda, *Appl. Phys. Lett.* **38**(5), 377 (1981).
4. M. Yang, D. Huang, P. Hao et al., *J. Appl. Phys.* **75**(1), 651 (1993).
5. Sh. B. Utamuradova, Kh. S. Daliev, Sh. Kh. Daliev, and K. M. Fayzullaev, *Applied Physics*, No. 6, 90 (2019) [in Russian].
6. Sh. B. Utamuradova, S. A. Muzafarova, A. M. Abdugafurov, K. M. Fayzullaev, E. M. Naurzalieva, and D. A. Rakhmanov, *Applied Physics*, No. 4, 90 (2021) [in Russian].
7. L. P. Pavlov, *Methods for measuring the parameters of semiconductor materials* (High school, Moscow, 1987).
8. Sh. T. Khojiev et al., *Universum: technical science* **73** (4), 84 (2020).
9. Y. Suzuki et al., *Journal of Fluorine Chemistry* **238**, 109616 (2020).
10. A. H. Kuptsova and G. N. Zhizhina, *Handbook of Fourier Transform Raman and Infrared Spectra of Polymers* (Elsevier, Amsterdam, 1998).
11. B. Talochkin, *J. Raman Spectrosc* **1**, 6 (2019).
12. S. Zhang, N. Mao, N. Zhang, J. Wu, L. Tong, and J. Zhang, *ACS Nano* **11**, 10366 (2017).
13. P. A. Temple and C. E. Hathaway, *Physical Review B* **7** (8), 3685 (1973).
14. K. Uchinokura, T. Sekine, and E. Matsuura, *Journal of Physics and Chemistry of Solids* **35** (2), 171 (1974).
15. I. Iatsunskiy, G. Nowaczyk, S. Jurga, V. Fedorenko, M. Pavlenko, and V. Smyntyna, *Optik – International Journal for Light and Electron Optics* **126** (18), 1650 (2016).
16. A. Wellner, V. Paillard, H. Coffin, N. Cherkashin, and C. Bonafos, *Journal of Applied Physics* **96** (4), 2403 (2004).
17. D. M. Zhigunov, G. N. Kamaev, P. K. Kashkarov, and V. A. Volodin, *Applied Physics Letters* **113** (2), 023101 (2018). doi:10.1063/1.5037008.
18. B. Graczykowski et al., *Nat. Commun.*, No. 8, 415 (2017).
19. Y. Duan, J. F. Kong, and W. Z. Shen, *J. Raman Spectrosc.* **43** (6), 756 (2012).
20. H. Campbell and P. M. Fauchet, *Solid State Communications* **58**, 739 (1986).
21. C. Smit et al., *Journal of Applied Physics* **94** (5), 3582 (2003). doi:10.1063/1.1596364.
22. E. Sachat et al., *Nature Communications* **8** (1), (2017). doi:10.1038/s41467-017-00115-4
23. I. Iatsunskiy, S. Jurga, V. Smyntyna, M. Pavlenko, V. Myndrul, and A. Zaleska, *Optical Micro- and Nanometrology V.* (2014). doi:10.1117/12.2051489
24. F. Cerdeira and M. Cardona, *Physical Review B* **5** (4), 1440 (1972). doi:10.1103/physrevb.5.1440.
25. C. Hensel, H. Hasegawa, and M. Nakayama, *Phys. Rev.*, No. 138, A225 (1965).
26. F. Laude, H. Pollak, and M. Cardona, *Phys. Rev. B* **3**, 2623 (1971).
27. J. J. Hall, *Phys. Rev.* **137**, A960 (1965).
28. V. M. Beilin, Yu. Kh. Velikov, and O. M. Krasil'nikov, *Sov. Phys. Solid State* **12**, 531 (1970).
29. P. Hermet, M. Khalil, R. Viennois, M. Beaudhuin, D. Bourgogne, and D. Ravot, *RSC Adv.* **5**, 19106 (2015).
30. P. Borowicz, M. Latek, W. Rzdokiewicz, A. Łaszcz, A. Czerwinski, and J. Ratajczak, *Advances in Natural Sciences: Nanoscience and Nanotechnology* **3**, 045003 (2012).