**Consideration and definition of optical phenomena**

**and properties of ultrathin crystalline films**

N.R.Vojnović1, A.J. Šetrajčić-Tomić2, S.M. Vučenović3,

I.J. Šetrajčić1, S.K. Jaćimovski4and J.P. Šetrajčić2

1*University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Vojvodina – Serbia*

2*Academy of Sciences and Arts of the Republic of Srpska, Banja Luka, Bosnia and Herzegovina*

3*University of Banja Luka, Faculty of Natural Sciences and Mathematics,*

*Banja Luka, Republic of Srpska – Bosnia and Herzegovina*

4***University of Criminal Investigation and Police Studies****, Zemun – Belgrade, Serbia*

e-mail:[jovan.setrajcic@gmail.com](mailto:jovan.setrajcic@gmail.com)

Today it is very well known and quite clear that the properties of nano-dimensional structures can differ significantly from the same structuresof bulk dimensions [1]. What is still a mystery is how to produce purposefully the nanostructures of precisely defined properties, in other words an adequate solution is still being sought to the question which conditions or parameters affect the change of physical properties and to what extent [2].

In this paper the theory of all optical phenomena (refraction, reflection, absorption and transparency) is presented in ultrathin crystal filmsalong the direction in which the film of nanoscopic dimensions is observed. The method of Green’s functions and the Kramers-Kronig relation [3] were used to define the indices of refraction, reflection, absorption and transparency. As these indices depend on the position of the crystallographic plane where optical phenomena occur in relation to two boundary planes [4], and in the experiment these values ​​can be seen/measured/determined only for the total film, the question arises as to how to define such values ​​of optical indices. This is exactly what has been done in this paper.

The results of these analyses were applied to a four-layered ultrathin molecular film in two cases: when the boundary planes of the film are free (without environmental influences) and when they are symmetrically perturbed. For the selected models, it has been shown that the effects of dimensional quantization and quantum size effect have a significantly greater impact on the change of optical properties than other boundary – confinement parameters. However, it should be noted that there is a very interesting result that may occur. It is possible that mono-absorption and enormous transparency may occurin the IR region in which such bulk crystals are absolute absorbers.

REFERENCES

[1] M. Fox, Optical Properties of Solids (2 ed.), ISBN 978-0199573370, [Oxford University Press](https://en.wikipedia.org/wiki/Oxford_University_Press).Oxford 2010, p. 44-46.

# [2] [G. Cao](https://www.worldscientific.com/author/Cao%2C+Guozhong), [Y. Wang](https://www.worldscientific.com/author/Wang%2C+Ying), Nanostructures and Nanomaterials: Synthesis, Properties, and Applications (2 ed.), [World Scientific Series in Nanoscience and Nanotechnology: Vol. 2](https://www.worldscientific.com/series/wssnn), pages 596; [doi: 10.1142/7885](https://doi.org/10.1142/7885), 2011.

[3] M. Fox, Optical Properties of Solids (2 ed.). ISBN 978-0199573370, [Oxford University Press](https://en.wikipedia.org/wiki/Oxford_University_Press). Oxford 2010, p. 44-46.

[4] A.J. Šetrajčić-Tomić, M. Vojnović, J.P. Šetrajčić, S.M. Vučenović, N.R. Vojnović, Opt. Quant. Electron. 52, 251 [1-18] (2020); doi: 10.1007/s11082-020-02371-z.