

519.21

«  
», 24- , 49600,  
. +38 (0562) 47-39-56, e-mail: volchuky@yandex.ua, ORCID ID: 0000-0001-8717-6786

( ).

«  
», 24- , 49600,  
. +38 (0562) 47-39-56, e-mail: volchuky@yandex.ua, ORCID ID: 0000-0001-8717-6786

( ).

## APPLICATION OF RESULTS OF WAVELET AND MULTIFRACTAL ANALYSIS OF METAL STRUCTURE FOR PROGNOSIS OF ITS QUALITY

VOLCHUK V. M., *Dr. Sc. (Tech.)*

Department of Materials Science, State Higher Education Establishment «Prydniprov'ska State Academy of Civil Engineering and Architecture», 24- Chernyshevskogo str., Dnipropetrovsk 49600, Ukraine, tel. +38 (0562) 47-39-56, e-mail: volchuky@yandex.ua, ORCID ID: 0000-0001-8717-6786

**Summary. Problem statement.** At present, to implement a deterministic method of assessment of the mechanical features is not possible based on the analysis of causal links, because they are influenced with a large number of variables that are highly correlated with each other, and some part of them are changing in a wide range of unpredictable ways.

Especially, this problem is in assessing the mechanical properties of metal constructions and products of special purpose in the process of their exploitation: oil pipes, carcasses of residential buildings, etc. In these cases, mechanical testing is the problem is not always technically feasible, and out of variety of express methods of non-destructive control are used often in practice in verbal or semiquantitative. The difficulty is that under the impact of various factors: temperature, corrosive environments, etc., structural changes occur far from thermodynamic equilibrium, and as result the mixed structures are got, including Widmannstätten structure. Use of classical methods of metallography is not always possible to quantify such structures with the precision that may be necessary for practical purposes. In this regard, considerable interest is the search for new approaches to assess the metal structure with a purpose of prognosis of its mechanical properties. **Purpose.** To obtain information about the possible application of wavelet-multifractal analysis to assess the mechanical properties of metal. **Conclusion.** Sensitiveness between strength properties and uniformity is set with regularity of structure elements of bainite-perlite group, and also between the viscous properties and uniformity, a regularity of element of the ferrite group. The results suggest that the realization of this method allows in the minimal and possible cost for the real tests to provide the necessary accuracy for practical purposes.

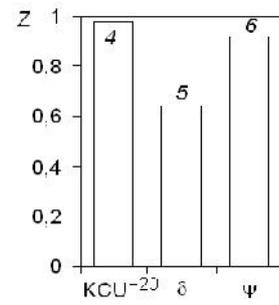
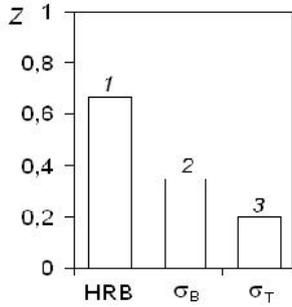
**Key words:** wavelet-multifractal analysis, the dimension, the mechanical properties, the prognosis

[1; 2].

( ).

[2].

[3].



. 1.

( ): 1 >  
4 >

; 2 >  
; 5 >

; 3 >  
; 6 >

3 (0,14 %)

930<sup>0</sup>

12

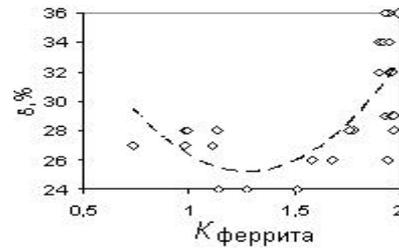
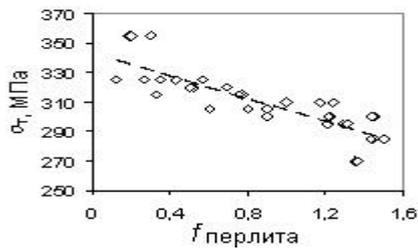
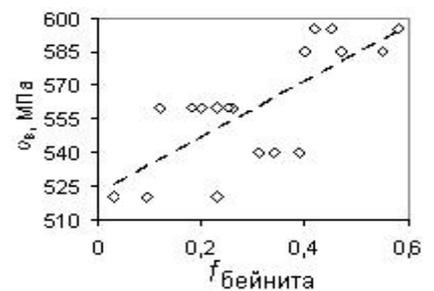
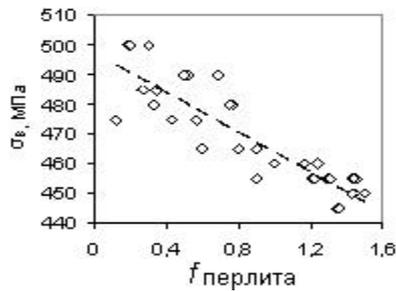
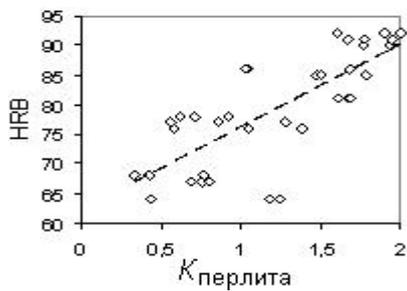
Ø 24 )

3 (

650<sup>0</sup>

400<sup>0</sup>

50<sup>0</sup>



. 2.

3

$$Z_i = \frac{|Y_i - Y_{i+1}|}{|X_i - X_{i+1}|}, \quad (1)$$

$Y_i$   $Y_{i+1}$

$i+1$

;  $X_i$   $X_{i+1}$

3

[4]:



## REFERENCES

1. Bol'shakov V.I. and Volchuk V.N. *Materialovedcheskie aspekty primeneniya veyvletno-mul'tifraktal'nogo podkhoda dlya otsenki struktury i svoystv malouglerodistoy stali* [Materials science aspects of the application of wavelet multifractal approach for assessing the structure and properties of low-carbon steel]. *Metallofizika i noveyshie tekhnologii* [Metal physics and advanced technologies]. Kiev, 2011, vol. 33, no 3, pp. 347-360. (in Russian).
2. Saltykov S.A. *Stereometricheskaya metallografiya (stereologiya metallicheskih materialov)* [Stereometric metallography (Stereology of metallic materials)]. Moscow: Metallurgiya, 1976, 270 p. (in Russian).
3. Bol'shakov V.I., Volchuk V.N. and Dubrov Yu.I. *Fraktaly v materialovedenii* [Fractals in material science]. Dnepropetrovsk: PGASA, 2005, 253 p. (in Russian).
4. Bol'shakov V.I. and Dubrov Yu.I. *Ob otsenke primenimosti yazyka fraktal'noy geometrii dlya opisaniya kachestvennykh transformatsiy materialov* [An estimate of the applicability of the language of fractal geometry to describe the qualitative transformation of materials]. *Dopov d Natsional'noy akademii nauk Ukrainy* [Reports National Academy of Sciences of Ukraine]. 2002, no. 4, pp. 116-121. (in Russian).

15.05.2015 . : - . . . .  
: 07.09.2015 . : 11.09.2015 .