MODELING OF SURFACE TOPOGRAPHY AFTER VAPOUR BLASTING

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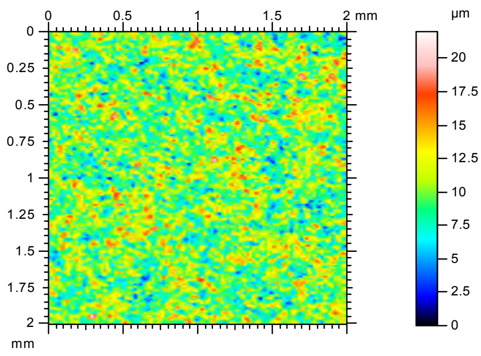
Vapour blasted surfaces are isotropic and have approximately a Gaussian height probability density function. This kind of surface can be easily modeled using numerical methods. There is a several methods of 3D surface topography simulation described by various authors. One of them is Auto – Regresive and Moving Average (ARMA) method [1, 2, 3]. Other popular methods of generating surface based on Fast Fourier Transform [4, 5, 6]. The FFT method was used to simulation of three dimensional surface created during vapour blasting treatment.

Several samples were processed by vapour blating. Feed system pressure of vapour blasting *p* was changed in the range of 0.3 – 0.6 MPa and distance between nozzle and sample was constant – 60 mm. After treatment, three dimensional measurement of surface topography was conducted.

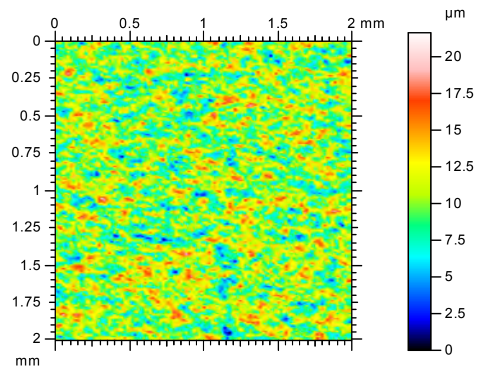
The surfaces were modeled using the FFT algorithm. Sq parameter of measured surface was one of the input data for the algorithm. Another input data were calculated as the average value of the correlation length for five randomly selected profiles in both direction CLx and CLy. All simulations were carried out using the Matlab.

a)



Height Parameters			Spatial Parameters		
Sq	2.58	µm	Sal	0.0247	mm
Ssk	0.182		Str	0.631	
Sku	3.17				
Sp	12	µm	**Hybrid Parameters**		
Sv	10	µm	Sdq	0.337	
Sz	22	µm	Sdr	5.44	%
Sa	2.02	µm			
Functional Parameters			**Correlation lengths**		
Smr	0.0143	%	CLx = 11 µm		
Smc	8.98	µm	CLy = 7 µm		
Sxp	5.01	µm			

b)



Height Parameters			Spatial Parameters		
Sq	2.58	µm	Sal	0.0247	mm
Ssk	0.0522		Str	0.448	
Sku	3.01				
Sp	11.3	µm	**Hybrid Parameters**		
Sv	10.3	µm	Sdq	0.338	
Sz	21.6	µm	Sdr	5.57	%
Sa	2.05	µm			
Functional Parameters			**Correlation lengths**		
Smr	0.00247	%	CLx = 12 µm		
Smc	8.01	µm	CLy = 8 µm		
Sxp	5	µm			

Fig. 1. Measured a) and modeled b) surface topography after vapour blasting and its parameters (p=0.4MPa)

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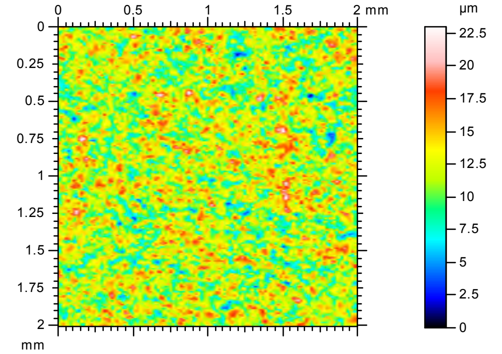
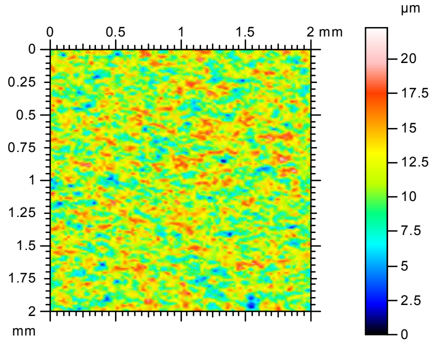
a)



Height Parameters			Spatial Parameters		
Sq	2.69	µm	Sal	0.0274	mm
Ssk	0.0593		Str	0.635	
Sku	3.12				
Sp	11	µm	**Hybrid Parameters**		
Sv	12	µm	Sdq	0.331	
Sz	23	µm	Sdr	5.26	%
Sa	2.11	µm			
			Correlation lengths		
Functional Parameters			CLx = 14µm		
Smr	0.0391	%	CLy = 13 µm		
Smc	7.98	µm			
Sxp	5.02	µm			

b)



Height Parameters			Spatial Parameters		
Sq	2.69	µm	Sal	0.0274	mm
Ssk	-0.0211		Str	0.438	
Sku	2.93				
Sp	10.9	µm	**Hybrid Parameters**		
Sv	11.4	µm	Sdq	0.331	
Sz	22.3	µm	Sdr	5.36	%
Sa	2.15	µm			
			Correlation lengths		
Functional Parameters			CLx = 13 µm		
Smr	0.0037	%	CLy = 13 µm		
Smc	7.4	µm			
Sxp	5.28	µm			

Fig. 2. Measured a) and modeled b) surface topography after vapour blasting and its parameters (p=0.5MPa)

Fig.1 and Fig. 2 show the results of surface topography modeling for different values of feed system pressure *p*.

The best match to the real parameters has been obtained for the parameters that were input data for modeling algorithm. Sq, CLx and CLy parameters were matched correctly and absolute mean value of their matching errors were very small. Relative differences between parameters Sa, Sal, Sdq obtained from simulation were very small too. Matching of parameters Sp and Sv in two cases was correct, but in the other two the relative error was much larger. Changes of the Smr parameter were high. The biggest error occurred in the case of Ssk parameter.

References:

1. Uchidate M., Yanagi K., Yoshidac I., Shimizu T., Iwabuchi A. Generation of 3D random topography datasets with periodic boundaries for surface metrology algorithms and measurement standards, Wear vol. 271 (3-4), 2011, pp. 565-570. 2. Hong M.S., Ehmann K.F. Three-dimensional surface characterization by two-dimensional autoregressive models. ASME J. of Tribology. 117, 1995, pp. 385-393.
3. Pawlus P., Reizer R., Dzierwa A. Simulation of profiles of normal ordinate distribution. Key Engineering Materials, vol. 381−382, 2008, pp. 113 − 116. 4. Hu Y.Z., Tonder K. Simulation of 3D random surface by 2D digital filter and Fourier analysis. International Journal of Machine Tools and Manufacture vol. 32, 1992, pp. 82–90. 5. Wu J.-J. Simulation of rough surfaces with FFT. Tribology International vol. 33, 2000, pp. 47–58. 6. Reizer R. Simulation of 3D Gaussian surface topography. Wear vol. 271 (3-4), 2011, pp. 539-543.

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