In parameters set #2 the laser power varying window narrows (105…110 W). The wall width decreases with increasing scanning velocity. At the velocity more than 12 m / min, the upper edge linearity is degraded (Fig. 4). To stabilize the process, further parameters miniaturization is required (transition to the parameters set #3). Walls with a minimum width of 140 ± 20 μm can be produced using parameters set #2.

In case of set #3 the LMD parameters reach extreme values: scanning speed is up to 14 m / min, laser power – below 105 W, powder mass flow – less than 0.15 g / min. The step Δz have to be reduced lower than 10 μm, when the powder mass flow is <0.125 g / min. It can not be realized in a laboratory system. Set # 3 allow to increase the resolution with a drastic deterioration of the upper edge linearity.

3D images of the walls produced with parameters set #2 are shown in Figure 5. For process stability reasons parameters sets #1, #2 (Table 2) are recommended.

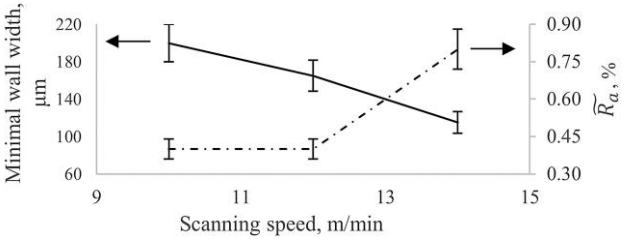

Fig. 4. Scanning velocity effect on the minimal wall width and on the upper edge linearity (set #2).

Table 2. Micro LMD parameter set of AlSi30 powder during manufacturing small-sized products

Parameter set	Powder mass flow, g/min	Power, W	Scanning velocity, m/min	z-increment Δz, μm
1	0,6…1,25	110…120	8…12	30…50
2	0,15…0,6	105…110	10…14	20…25

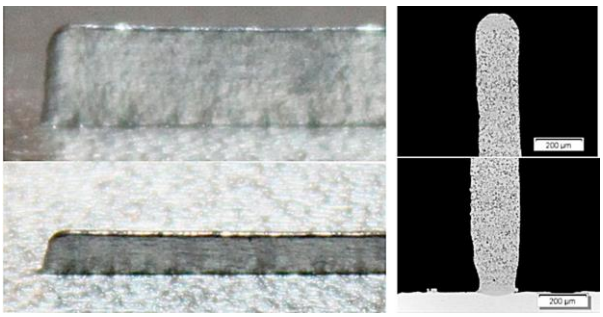

Fig. 5. Thin-walled objects produced by micro LMD of AlSi30 powder (parameter set #2)

3.3 Lattice structure

Lattice structure was produced by micro LMD of AlSi30 powder (**Ошибка! Источник ссылки не найден.**). To minimize the material storage effect at the scanning path point of intersection the preferred Δz-increment value is chosen. Shift in the vertical direction is made after every second layer. Lattice structures can be used to control the surface

roughness and its aerodynamic and hydrodynamic properties during the flow through a liquid or gas stream and to ensure adhesion in applying thermal spray coatings.

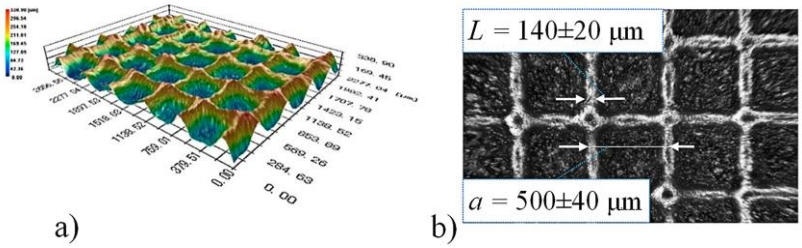

Fig. 6. Lattice structure, produced by micro LMD: a – 3D-view, b – top view (parameters set #2).

4 Conclusions

Experimental data were obtained, that have significant importance to micro LMD development of Al-matrix composites (AMCs). AlSi30 powders were used as clad material, which thermal-physical properties can be estimated with sufficient reliability. For this reason obtained data can be used to validate computational models of heat transport during micro LMD.

The influence of the powder particle size and the cladding parameters on the minimal width and the quality of the fabricated thin walls was investigated.

The thin walls with the minimal width of 140 μm and surface roughness Ra 1,5 μm were generated.

Laser micro cladding potential to manufacture lattice-shaped structures of Al-matrix composites was demonstrated. Fabricated thin-wall structures can have application in different fields e.g. aviation, automotive and tooling industries.

The work is performed with financial support of the Ministry of Education and Science of Russian Federation within the framework of state assignment № 11. 1267. 2017 / ПЧ.

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