FEATURES OF QUALITY CONTROL OF ADDITIVE MANUFACTURING PRODUCTS

Pupan L. I.
National Technical University «Kharkiv Polytechnic Institute», Kharkiv

Determining the quality parameters of additive manufacturing products is not a trivial task, since the quality of products obtained using layer-by-layer technology is determined by a large number of factors at various stages of production. Influencing factors are the physical, chemical and mechanical properties of the raw material; technological parameters of a specific process; characteristics of laser radiation (for SLA, SLS, SLM and other methods); mode of layer-by-layer growth, composition of the atmosphere in which the process takes place, etc.

Most of the operational properties of additive manufacturing (AM) products, such as wear resistance, fatigue resistance, corrosion resistance, vibration resistance, are determined by the parameters of the surface layer of AM products – surface roughness, structure parameters.

To determine the parameters of the surface layer of AM products various techniques are used – both standard, modified, and original ones, adapted to the peculiarities of layer-by-layer creation.

For example, control of roughness parameters is carried out by profilometers, profilometers-profilographs with high resolution ~ 0.01 microns and small measurement errors ~ ± 3…5 %.

Important indicators of the quality of the surface layer of additive manufacturing products include structural factors, primarily the presence of technological defects, the nature of which is determined by the AM process.

Typical defects observed in products made of metallic materials (SLS, SLM) include lack of penetration (delamination), shrinkage porosity, gas porosity, microcracks, thermal stresses. Typical defects in polymer and composite AM products include low interlayer adhesion, warping, lack of a layer, the presence of microcracks, and the formation of macro- and microporosity.

Traditional optical and electron microscopy (transmission and scanning), X-ray diffraction, and X-ray microanalysis techniques can be used to control the quality of structural defects. However, the use of these methods is not sufficient to analyze the complex additive manufacturing objects, which is due to the following factors: these methods are destructive in nature, which is negative point given the high cost of consumables; some methods require labor-intensive and time-consuming sample preparation; preparing samples for testing results in artifacts.

The most promising modern methods of non-destructive testing of AM products, allowing to identify both surface and internal structure defects and even measure their parameters with high accuracy, are ultrasound imaging, neutron tomography, and X-ray computed tomography. A special role is given to methods of quality control of AM products based on real-time monitoring, included directly into the technological process of layer-by-layer creation (in situ methods), such as high-speed capture processes (CCD cameras), pyrometry, infrared thermography.