How to Improve the Quality of a Laser Beam by Homogenization

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It is very important to improve the quality of the laser beam in oncology, cosmetology, dentistry. In cases of radiation therapy or the laser modification, the intensity should be homogeneous everywhere, because only the exact laser fluence and well-controlled irradiation time lead to the required result. Very often, the applied laser radiation has an inhomogeneous intensity distribution. So it is necessary to create a device for the beam transformation. The goal of my research was to create the device solving the problem of heterogeneity of the laser radiation. Device should be more efficient than the competitors existing in the world. To create a homogeneous beam, an array of microspheres immersed in a liquid was used. Each sphere acts as a separate diffuser with the following superposition of all spots. Immersion liquid helps to adjust device operating distance by the refractive index variation. Since the fluids are not suitable for the high power lasers, a solid medium with similar optical properties was created. To optimize the size of the spheres, a theoretical model was proposed that takes into account the focusing of light in microspheres and the diffraction of transmitted radiation. Varying the size of the spheres shows that the best microspheres size for visible light is 200-300 microns. To improve the efficiency of the device, the microspheres were sorted. To confirm the homogeneity of the intensity distribution, the received flux was scanned by a small photodiode. As a result, I obtained an array of microspheres immersed in a solid media that make it possible to convert the radiation into necessary one. Thus, the device was quite efficient, inexpensive and easy to make. In this version the prototype is suitable for high power lasers.

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