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PRINCIPLE OF LASER OPERATION. INTERFERENCE COATING CALCULATION FOR THE OPTICAL ELEMENT OF A SOLID-STATE LASER

© Rymzhina A.R., Avdeiko S.A.

Samara National Research University, Samara, Russian Federation

e-mail: nastya.rymzhina.98@mail.ru

Nowadays, contemporary optical coatings have a complex structure that improves optical element properties. To apply them calculations and modern equipment are used.

The article presents the principle of laser operation, its general classification and the interference coating calculation results for two sides of a DPSS laser cavity end mirror.

The relevance of interference coating calculations lies in the necessity of achieving the required percentage of radiation transmission through the cavity end mirror at specific wavelengths.

The article gives detailed information about coating calculation results illustrated in the form of descriptive graphs and tables.

All lasers consist of 3 parts: an external pump source, an active medium and a cavity. A pump source directs external energy into the cavity. The active medium is located inside the cavity. The classification of lasers is based on the material of the active element. Depending on the design, the active medium can be a gas mixture, crystal, semiconductor or glass fiber. The radiation in the active medium is amplified by a cavity. Thus, a monochromatic, coherent and directional beam of light is induced. Only radiation of a certain wavelength can penetrate the cavity through the cavity end mirror and that of another wavelength leaves the cavity through the output mirror. The directional radiation transmitted through the output mirror is called laser radiation.

The MCalc software was used to calculate the antireflection and reflection interference coatings for the cavity end mirror. Titanium oxide was chosen as the coating material with a higher refractive index, and silicon oxide was chosen as the coating material with a lower refractive index. The number of layers was selected by reasons of the possibility of producing such a coating in practice, provided that the necessary percent of radiation transmission at specific wavelengths (808 nm and 1064 nm) was provided.

The results of the carried out calculations demonstrate that to achieve the necessary radiation transmission at a wavelength of 808 nm, a two-layer coating is required – a layer of silicon oxide and that of a titanium oxide. For simultaneous radiation transmission at a wavelength of 808 nm and radiation reflection at a wavelength of 1064 nm, a 15 layer coating of silicon oxide and titanium oxide is required.

The calculated complex coatings provide the necessary fraction of radiation reflection and transmission at given wavelengths. The need for such calculations lies in the fact that in order to achieve the required percent of transmission at specific wavelengths, specific interference coatings are applied. Qualitative calculation implies the possibility of fabricating of optical elements with a similar coating, that is, the number of layers should not be too large, and their thickness should not be too small. Thus, the calculation performed fully satisfies the requirements for coatings of optical elements, proving out the fact that this coating can be obtained in practice [1–4].

The outcomes of this work can be used for application of such a coating in laser optics.

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