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Optical properties and laser damage threshold of rapid-grown KDP crystals

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Transparency of a KDP crystal grown at a rate of $V = 15$ mm/day has been studied in a wide wavelength range. A noticeably nonuniform distribution coefficient α over crystal volume has been found in the UV part of the spectrum. In the visible and IR parts the difference in the α values for different points of the crystal is much less. The value of laser damage threshold (1.06 μm, 10 ns) for the samples cut of the growth sectors (100) and (101) has been measured. The obtained results showed an significant difference of this parameter (1.5–2 GW/cm^2) for different growth sectors. Measurements of electrical resistivity ρ demonstrated its dependence on chemical composition of the crystals. A comparison of the α, W and ρ values for rapidly and traditionally grown crystals has been made.

В широком диапазоне длин волн (200–1100 нм) исследована прозрачность монокристаллов KDP, выращенных при скоростях $V = 15$ мм/сутки. В УФ-области спектра обнаружено существенно неоднородное распределение коэффициента поглощения α по объему кристалла. В видимой и ИК-областях отличия в значениях α для различных точек кристалла значительно уменьшаются. Проведены измерения величины порога лазерного повреждения ($\lambda = 1.06$ мкм, $\tau = 10$ нс) для образцов, вырезанных из секторов роста (100) и (101). Полученные результаты показали незначительное различие этого параметра (1.5–2.0 ГВт/см^2) для разных секторов роста. Измерения удельного электрического сопротивления показали зависимость ρ от примесного состава кристаллов. Проведено сравнение значений α, W и ρ кристаллов, выращенных в скоростных и традиционных условиях.

The problem of large-size KDP single crystals is of considerable urgency in connection with use thereof as frequency transformers of wide-aperture laser radiation in controlled thermonuclear synthesis apparatus with inertial plasma confining. The KDP crystals met today the all relevant requirements to the greatest extent. Those requirements include the transformation efficiency, radiation resistance, and possibility of large size crystal manufacturing. Traditional production methods of large crystals have one principal drawback consisting in low growth rates (1 to 2 mm/day), thus, the manufacturing duration of each crystal exceeds one year. This instance has stimulated development of novel methods of rapid crystal growing that would provide a substantial shortening of the process duration under retaining the acceptable optical quality [1–3].

If a crystal is grown from a point seed, it contains both pyramidal facets and pris-