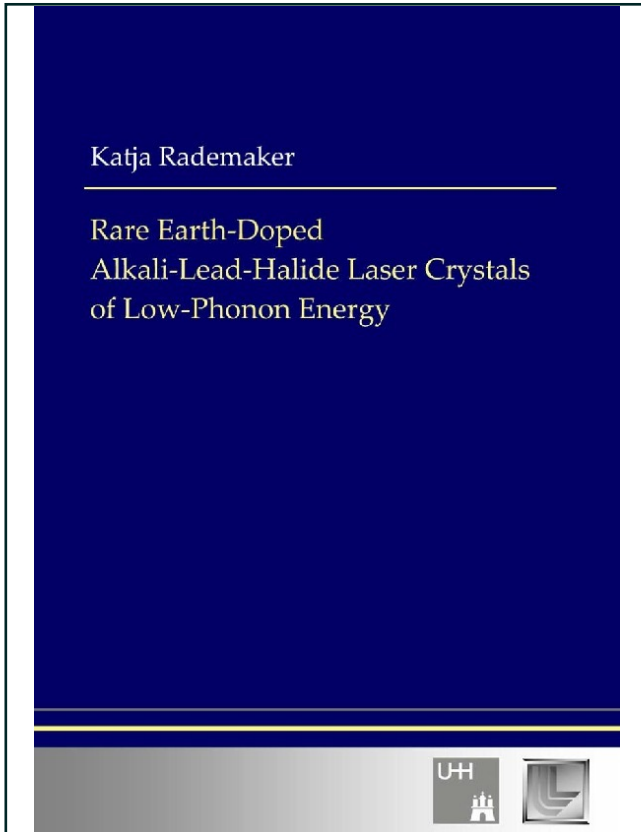




Katja Rademaker (Autor)

Rare Earth-Doped Alkali-Lead-Halide Laser Crystals of Low-Phonon Energy



<https://cuvillier.de/de/shop/publications/2358>

Copyright:

Cuvillier Verlag, Inhaberin Annette Jentsch-Cuvillier, Nonnenstieg 8, 37075 Göttingen,
Germany

Telefon: +49 (0)551 54724-0, E-Mail: info@cuvillier.de, Website: <https://cuvillier.de>

Table of Contents

ABSTRACT	III
KURZDARSTELLUNG	IV
1. INTRODUCTION	1
1.1 Motivation and Background	1
1.2 Theoretical Aspects	6
1.2.1 Energy Splitting of Trivalent Rare Earth Ions	6
1.2.2 Radiative Transitions	7
1.2.2.1 Transition Probabilities from Absorption Spectra (Judd-Ofelt Theory).....	8
1.2.2.2 Transition Probabilities from Emission Spectra	13
1.2.3 Nonradiative Decay: Multiphonon Relaxation and Other Quenching Mechanisms.....	13
2. PREPARATION AND EXPERIMENTAL METHODS.....	21
2.1 Preparation of RE ³⁺ -Doped KPb ₂ Br ₅ and RbPb ₂ Br ₅ Crystals.....	21
2.1.1 Crystal Growth: Procedure and Results	21
2.1.2 Physical Properties	24
2.2 Measurements and Data Evaluation.....	27
2.2.1 Raman Scattering	27
2.2.2 Absorption	27
2.2.3 Emission	28
2.2.4 Excitation	29
2.2.5 Emission Lifetime	30
2.2.6 Pump-Probe- and Gain-Measurements	30
2.2.7 Laser Experiments.....	32
3. SPECTROSCOPY AND LASER OPERATION	35
3.1 Phonon Energies of Bromides Versus Other Host Crystals.....	35
3.2 Slow Nonradiative Decay for RE ³⁺ -Doped Bromide Crystals.....	38
3.2.1 Nd ³⁺ -Doped KPb ₂ Br ₅ and RbPb ₂ Br ₅ Crystals.....	38
3.2.1.1 Absorption and Radiative Transition Probabilities.....	39
3.2.1.2 Emission, Branching Ratios, and Quantum Efficiencies.....	42
3.2.1.3 Emission Lifetime and Quantum Efficiencies	44
3.2.2 Tb ³⁺ -Doped KPb ₂ Br ₅ Crystals.....	46
3.2.2.1 Absorption and Radiative Transition Probabilities.....	46
3.2.2.2 Emission	49
3.2.2.3 Emission Lifetime and Quantum Efficiencies.....	50
3.2.3 Eu ³⁺ -Doped KPb ₂ Br ₅ Crystals: Absorption and Radiative Transition Probabilities.....	52
3.2.4 Low Multiphonon Decay Rates for Bromide Crystals	55
3.3 Temperature Dependent Quenching in Tb ³⁺ -Doped KPb ₂ Br ₅ Crystals	57
3.3.1 Emission Lifetimes of the ⁷ F ₄ and ⁷ F ₅ Level Versus Temperature	58
3.3.2 Emission Intensities and Rise Time Versus Temperature	63
3.3.3 Emission from the ⁷ F ₃ Level	65
3.4 Low Temperature Spectroscopy of Nd ³⁺ -Doped KPb ₂ Br ₅ Crystals	66
3.5 Laser Activity in Nd ³⁺ -Doped KPb ₂ Br ₅ and RbPb ₂ Br ₅ Crystals.....	70
3.6 Optical Pump-Probe Processes and Depopulation Mechanisms of the Lower Laser Levels in Nd ³⁺ -Doped KPb ₂ Br ₅ , RbPb ₂ Br ₅ , and KPb ₂ Cl ₅	73
3.7 Upconversion Processes in Nd ³⁺ -Doped KPb ₂ Br ₅ Crystals	84
4. SUMMARY AND OUTLOOK	89
REFERENCES	95
APPENDIX	107

ACKNOWLEDGMENTS 113