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Growth and characterization of Co-doped spinels of laser interest

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The luminescence properties of tetrahedrally coordinated $\text{Co}^{2+}(\text{d}^7)$ ion in spinels were studied in [1,2]. A combination of broad luminescence transitions coupled with a large oscillator strength makes Co^{2+} -doped spinels interesting candidates for tunable solid-state lasers in the visible and near infrared. In this paper optical absorption and luminescence of divalent cobalt have been studied in MgAl_2O_4 (MALO) and ZnGa_2O_4 (ZGO) spinels. The crystals were grown by the Verneuil (MALO) and flux (ZGO) methods. The absorption bands at 7200, 17000 and 21000 cm^{-1} are assigned to transitions from the $^4\text{A}_2(^4\text{F})$ ground state to the $^4\text{T}_1(^4\text{F})$, $^4\text{T}_1(^4\text{P})$ and $^2\text{T}_1(^2\text{P})$ excited states of tetrahedrally coordinated Co^{2+} , respectively. Saturation of the Co^{2+} absorption at 540 nm was measured in MALO and peak absorption cross section for $^4\text{A}_2(^4\text{F}) - ^4\text{T}_1(^4\text{P})$ transition was estimated to be $4 \times 10^{-19} \text{ cm}^2$. The broad luminescence bands observed in the visible at 670 nm and in the near infrared at 880 nm and 1290 nm are assigned to transitions from the $^4\text{T}_1(^4\text{P})$ excited level to the lower lying $^4\text{A}_2(^4\text{F})$, $^4\text{T}_2(^4\text{F})$ and $^4\text{T}_1(^4\text{F})$ levels, respectively. The temperature behavior of the emission intensity and decay time in MALO indicated strong luminescence quenching at room temperature. The emission decay time in ZGO varied from 0.85 μs at 77 K to 1.1 μs at room temperature. No spectroscopic evidence for octahedrally coordinated Co^{2+} has been observed.

References

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