

Luminescence property and thermal stability of Erbium doped Silicon-rich Si nitride

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The luminescence property and thermal stability of erbium-doped silicon-rich silicon nitride (SRSN:Er) are investigated. SRSN:Er films with varying Si content were prepared by reactive ultra-high vacuum ion beam sputtering followed by high temperature annealing for precipitation of nanocluster Si (nc-Si). We find that nc-Si in SRSN:Er can act as efficient sensitizers for Er³⁺, allowing off-resonant broadband pumping of Er³⁺. Er³⁺ luminescence lifetimes were in 1-3 msec range at room temperature with nearly complete suppression of temperature quenching of Er³⁺ PL intensity, indicating high luminescence efficiency. Comparison with a similarly prepared Er-doped Si-rich Si oxide (SRSO:Er) using off-resonantly and resonantly pumped photoluminescence and photoluminescence excitation spectroscopy shows that the nc-Si sensitization is much more effective in SRSN:Er films while the optical de-activation of Er after high-temperature anneals is completely absent, suggesting that SRSN:Er is a promising alternative to SRSO:Er for a compact, low-cost Si based light source^{1,2}.

[References]

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