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Supplementary Materials

Bright Silicon Carbide Single-Photon Emitting Diodes at Low Temperatures: Toward Quantum Photonics Applications

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Table S1. Material parameters with temperature dependencies used in the numerical simulations.

Parameter	Model	Comments
Energy bandgap	$E_{gap}(T) = E_{gap}(0) - \frac{\alpha T^2}{\beta + T}$, where $E_{gap}(0)$ = 3.26 eV, α = 6.5×10^{-4} eV/K, β = 1300 K	[1]
Electron SRH lifetime	$\tau_{SRH}^{n}(T) = \frac{\tau_{SRH}^{n}(300) \times \left(\frac{T}{300}\right)^{1.5}}{1 + \frac{N}{N_{ref}}}$, where $\tau_{SRH}^{n}(300)$ = 340 ns, N_{ref} = 10^{17} cm^{-3}	[2–4]
Hole SRH lifetime	$\tau_{SRH}^{p}(T) = \frac{\tau_{SRH}^{p}(300) \times \left(\frac{T}{300}\right)^{-0.5}}{1 + \frac{N}{N_{ref}}}$, where $\tau_{SRH}^{p}(300)$ = 100 ns, N_{ref} = 10^{17} cm^{-3}	[2–4]
Electron surface recombination velocity	$S_n(T)$ = *const* = 10^5 cm/s	[5]
Hole surface recombination velocity	$S_p(T)$ = *const* = 10^5 cm/s	[5]
Electron saturation velocity	Si-like dependence $\upsilon_{sat}^{n}(T) = \frac{\upsilon_{sat}^{n}(0)}{1 + 0.8\exp\left(\frac{T}{600}\right)}$, where $\upsilon_{sat}^{n}(0)$ = 5.1×10^7 cm/s, which gives $\upsilon_{sat}^{n}(300)$ = 2.2×10^7 cm/s	[6,7]
Hole saturation velocity	Si-like dependence $\upsilon_{sat}^{p}(T) = \frac{\upsilon_{sat}^{p}(0)}{1 + 0.8\exp\left(\frac{T}{600}\right)}$, where $\upsilon_{sat}^{p}(0)$ = 3.5×10^7 cm/s, which gives $\upsilon_{sat}^{p}(300)$ = 1.5×10^7 cm/s	[1,7]

Electron low-field mobility in the p⁺-type region	$\mu_n(T) = \mu_n(300) \times \left(\frac{T}{300}\right)^{-0.52}$, where $\mu_n(300)$ = 420 cm²/Vs	[8–10]
Hole low-field mobility in the p⁺-type region	$\mu_p(T) = \mu_p(300) \times \left(\frac{T}{300}\right)^{-0.93}$, where $\mu_p(300)$ = 170 cm²/Vs	[8–10]
Electron low-field mobility in the i-type region	$\mu_n(T) = \mu_n(300) \times \left(\frac{T}{300}\right)^{-1.59}$, where $\mu_n(300)$ = 700 cm²/Vs	[8–10]
Hole low-field mobility in the i-type region	$\mu_p(T) = \mu_p(300) \times \left(\frac{T}{300}\right)^{-1.59}$, where $\mu_p(300)$ = 220 cm²/Vs	[8–10]
Electron low-field mobility in the n⁺-type region	$\mu_n(T) = \mu_n(300) \times \left(\frac{T}{300}\right)^{-0.52}$, where $\mu_n(300)$ = 420 cm²/Vs	[8–10]
Hole low-field mobility in the n⁺-type region	$\mu_p(T) = \mu_p(300) \times \left(\frac{T}{300}\right)^{-0.93}$, where $\mu_p(300)$ = 170 cm²/Vs	[8–10]
Donor activation energy	$E_d(T) = const$ = 0.053 eV (hex site), 0.1 eV (cubic site)	[11]
Acceptor activation energy	$E_a(T) = const$ = 0.2 eV	[12]
Electron DOS mass in the conduction band	$m_e(T) = const = 0.77m_0$, where m_0 is the electron rest mass.	[13]
Hole DOS mass in the valence band	$m_h(T) = const = 0.91m_0$, where m_0 is the electron rest mass.	[14]

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