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of granted spec.

ABSTRACT

A resin-sealed semiconductor device which comprises a lead frame having a die bond pad and an inner lead, a semiconductor chip installed on the die bond pad via a die bonding material and a sealing material for sealing the semiconductor chip and the lead frame, wherein properties of the die bonding material and the sealing material after curing satisfies the following formulae: $\sigma_e \leq 0.2 \times \sigma_b$ formula (1) $U_i \geq 2.0 \times 10^{-6} \times \sigma_{ei}$ formula (2) $U_d \geq 4.69 \times 10^{-6} \times \sigma_{ed}$ formula (3) wherein σ_b (MPa) represents the flexural strength at break of the sealing material at 25°, U_i (N·m) and U_d (N·m) represent shear strain energies of the sealing material at a soldering temperature for the inner lead and the die bonding pad, respectively, at a peak temperature during soldering, where $\sigma_e = (1/\log(kd_1)) \times Ee_1 \times (\alpha_m - \alpha_{e1}) \times \Delta T_1$ formula (4), $\sigma_{ei} = Ee_2 \times (\alpha_{e2} - \alpha_m) \times \Delta T_2$ formula (5), $\sigma_{ed} = \log(kd_2) \times Ee_2 \times (\alpha_{e2} - \alpha_m) \times \Delta T_2$ Formula (6), kd_1 : a ratio of the flexural elastic modulus E_{d1} (MPa) of the die bonding material at 25° to 1 MPa of elastic modulus ($E_{d1} > 1$ MPa), kd_2 : a ratio of the flexural elastic modulus E_{d2} (MPa) of the die bonding material at the peak temperature during the soldering to 1 MPa of elastic modulus ($E_{d2} > 1$ MPa), Ee_1 : a flexural modulus (MPa) of the sealing material at 25°, Ee_2 : a flexural modulus (MPa) of the sealing material at the peak temperature during soldering, α_{e1} : an average thermal expansion coefficient (1/°C) of the sealing material from forming temperature for the semiconductor to room temperature (25°C), α_{e2} : an average thermal expansion coefficient (1/°C) of the sealing material from the forming temperature for the semiconductor to a peak temperature during soldering, α_m : a thermal expansion coefficient (1/°C) of the lead frame, ΔT_1 : the difference (°C) between the forming temperature for the semiconductor and the low temperature side temperature in the temperature cycle, and ΔT_2 : the difference (°C) between the forming temperature for the semiconductor and the peak temperature during soldering.



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