S STUDENTS

National Student Team Contest (first stage)
Solution of task 7. Heating nanowires

Tabulated values are listed below:

	C, specific heat	ρ, density	α, absorption coefficient
Ge	0,31 kJ/(kg K)	5320 kg/m^3	2,0·10^5 cm^{-1}
Si	0,68 kJ/(kg K)	2330 kg/m^3	3,7·10^3 cm^{-1}

The energy necessary for heating:

$$Q = cm\Delta t = c\rho SL\Delta t.$$

The energy for heating is obtained from absorbed radiation:

$$I_{absorbed} = I_0\big(1 - exp(-\alpha L)\big),\ Q = I_{absorbed}\tau S.$$

Equating:

$$c\rho SL\Delta t = I_0\big(1 - exp(-\alpha L)\big)\tau S.$$

Thus we obtain:

$$\Delta t = \frac{I_0\big(1-exp(-\alpha L)\big)\tau}{c\rho L}.$$

Let's estimate the temperature change for Ge:

$$\Delta t = \frac{3\cdot 10^7\ W/m^2\left(1 - exp(-2{,}0\cdot 10^5 cm^{-1}10^{-5}cm)\right)10sec}{305\frac{J}{kg\cdot K}5320\frac{kg}{m^3}10^{-7}m} \approx 1{,}6\cdot 10^8 K > T_{fusion}$$

Similarly for Si:

$$\Delta t = \frac{3\cdot 10^7 W/m^2\left(1-exp\left(-3{,}7\cdot 10^3 cm^{-1}10^{-5}cm\right)\right)10sec}{678\frac{J}{kg\cdot K}2330\frac{kg}{m^3}10^{-7}m} \approx 7\cdot 10^7 K > T_{fusion}.$$