Answer on Question #51438, Physics, Solid State Physics

How much mass does an electron gain when it is accelerated to a kinetic energy of 500 keV?

Solution:

Mass–energy equivalence for electron $m_0c^2 = 511keV$.

The kinetic energy of electron is given by Eq.(1)

$$E_K = mc^2 - m_0c^2 \quad (1)$$

where $m = m_0 / \sqrt{1 - v^2/c^2}$, $m_0 = 9.1 \cdot 10^{-31} kg$ is the electron mass of tranquility; c is the velocity of light; v is the velocity of the electron.

From Eq.(1)

$$m = \frac{E_K + m_0c^2}{c^2} = \frac{8.176 \cdot 10^{-14} + 8 \cdot 10^{-14}}{\left(3 \cdot 10^8\right)^2} = 1.8 \cdot 10^{-30} kg \quad (2)$$

where $m_0c^2 = 511keV = 8.176 \cdot 10^{-14} J$; $E_K = 500keV = 8.000 \cdot 10^{-14} J$

Answer: $m = \frac{E_K + m_0c^2}{c^2} = \frac{8.176 \cdot 10^{-14} + 8 \cdot 10^{-14}}{\left(3 \cdot 10^8\right)^2} = 1.8 \cdot 10^{-30} kg$