

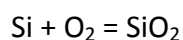
Question #73788, Chemistry / Physical Chemistry / Completed

To make a thin film of SiO₂ in a vacuum chamber, you start with 1.00 mm x 1.00 mm piece of Mo metal as the substrate to build your film on. The first step of the process is to put down a 0.010 mm thick film of Si atoms onto the piece of Mo metal. This Si film has a density of 8.41 x 10²² atoms/mL. The next step is to oxidize the film with O₂ gas. You need two Oxygen atoms for every one silicon atom you have in the film. How many O atoms do you need to make the SiO₂ film?

b) This process is only 20. % efficient (meaning 1 atom in 5 react). What is the minimum number of O atoms you need to make the SiO₂ film?

c) If there are 1.4 x 10²² O₂ molecules/mL of gas, how many L do you need?

Solution



The volume of the Si layer: $V = 1 \text{ mm}^2 \times 0.010 \text{ mm} = 0.010 \text{ mm}^3$ or $1\text{e-}5 \text{ mL}$.

The number of atoms of Si: $1\text{e-}5 \text{ mL} \times 8.41 \times 10^{22} \text{ atoms/mL} = 8.41\text{e+}17 \text{ atoms}$.

The number of O atoms (theory): $8.41\text{e+}17 \cdot 2 = 1.682\text{e+}18$.

b)

$1.682\text{e+}18 \text{ atoms} \cdot 100\% / 20\% = 8.41\text{e+}18 \text{ atoms}$.

c)

$8.41\text{e+}18 \text{ atoms} / 1.4 \times 10^{22} \text{ O}_2 \text{ molecules/mL} = 6.007\text{e-}4 \text{ mL}$

Answer: 1.682e+18; 8.41e+18; 6.007e-4 mL.

Answer provided by AssignmentExpert.com