Answer on the question #55732 - Chemistry - Physical Chemistry

Question:

a sample of lead weighing 1.05g was dissolved in a small quantity of nitric acid to produce aqueous solution of Pb2+ and Ag+(which is present as impurity).the volume of the solution was increased to 300ml by adding water, a pure silver electrode was immersed in the solution and the potential difference between this electrode and the standered electrode was found to be 0.503V at 25 degree celcius. what was the %of Ag in the lead metal? Given E0 (Ag+/Ag)=0.799v.neglecting amount of Ag+ converted to Ag.

Solution:

The mass fraction of silver is:

$$\omega = \frac{m(Ag)}{m(sample)},$$

where $m(sample)$ is 1.05 g. Let's find the concentration of silver in solution. For this, we can use Nernst equation:

$$E = E^0 + 0.0591 \cdot \ln[Ag^+]$$

$$0.503 = 0.799 + 0.0591 \cdot \ln[Ag^+]$$

$$\ln[Ag^+] = -5.01$$

$$[Ag^+] = 6.68 \cdot 10^{-3}\ mol\ L^{-1}$$

The number of the moles of Ag^+ in 300 ml solution is:

$$n(Ag) = [Ag^+] \cdot V = 6.68 \cdot 10^{-3} \cdot 300 \cdot 10^{-3} = 2.00 \cdot 10^{-3}\ mol$$

The mass of the silver is:

$$m(Ag) = n(Ag) \cdot M(Ag) = 2.00 \cdot 10^{-3} \cdot 107.8682 = 0.216\ g$$

Mass fraction of the silver is:

$$\omega = \frac{0.216}{1.05} = 0.21, or\ 21\%$$

Answer: 21% of Ag