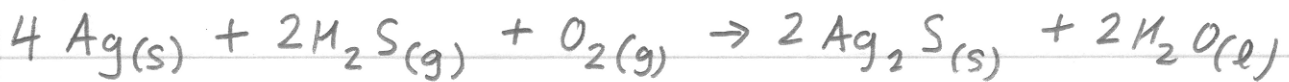


## Thermodynamics of Silver Tarnishing



$$\Delta_r H^\circ = 2 \Delta_f H^\circ(\text{Ag}_2\text{S}(s)) + 2 \Delta_f H^\circ(\text{H}_2\text{O}(l))$$

$$- 4 \Delta_f H^\circ(\text{Ag}(s)) - 2 \Delta_f H^\circ(\text{H}_2\text{S}(g)) - \Delta_f H^\circ(\text{O}_2(g))$$

$$= [2(-31.8) + 2(-285.84) - 4(0) - 2(-20.2) - 0] \text{kJ mol}^{-1}$$

$$\Delta_r H^\circ = -594.88 \text{ kJ mol}^{-1}$$

$$\Delta_r S^\circ = 2 S^\circ(\text{Ag}_2\text{S}(s)) + 2 S^\circ(\text{H}_2\text{O}(l)) - 4 S^\circ(\text{Ag}(s))$$

$$- 2 S^\circ(\text{H}_2\text{S}(g)) - S^\circ(\text{O}_2(g))$$

$$= [2(146) + 2(69.94) - 4(42.702) - 2(205.6) - 205.0] \text{J mol}^{-1} \text{K}^{-1}$$

$$\Delta_r S^\circ = -355.13 \text{ J mol}^{-1} \text{K}^{-1}$$