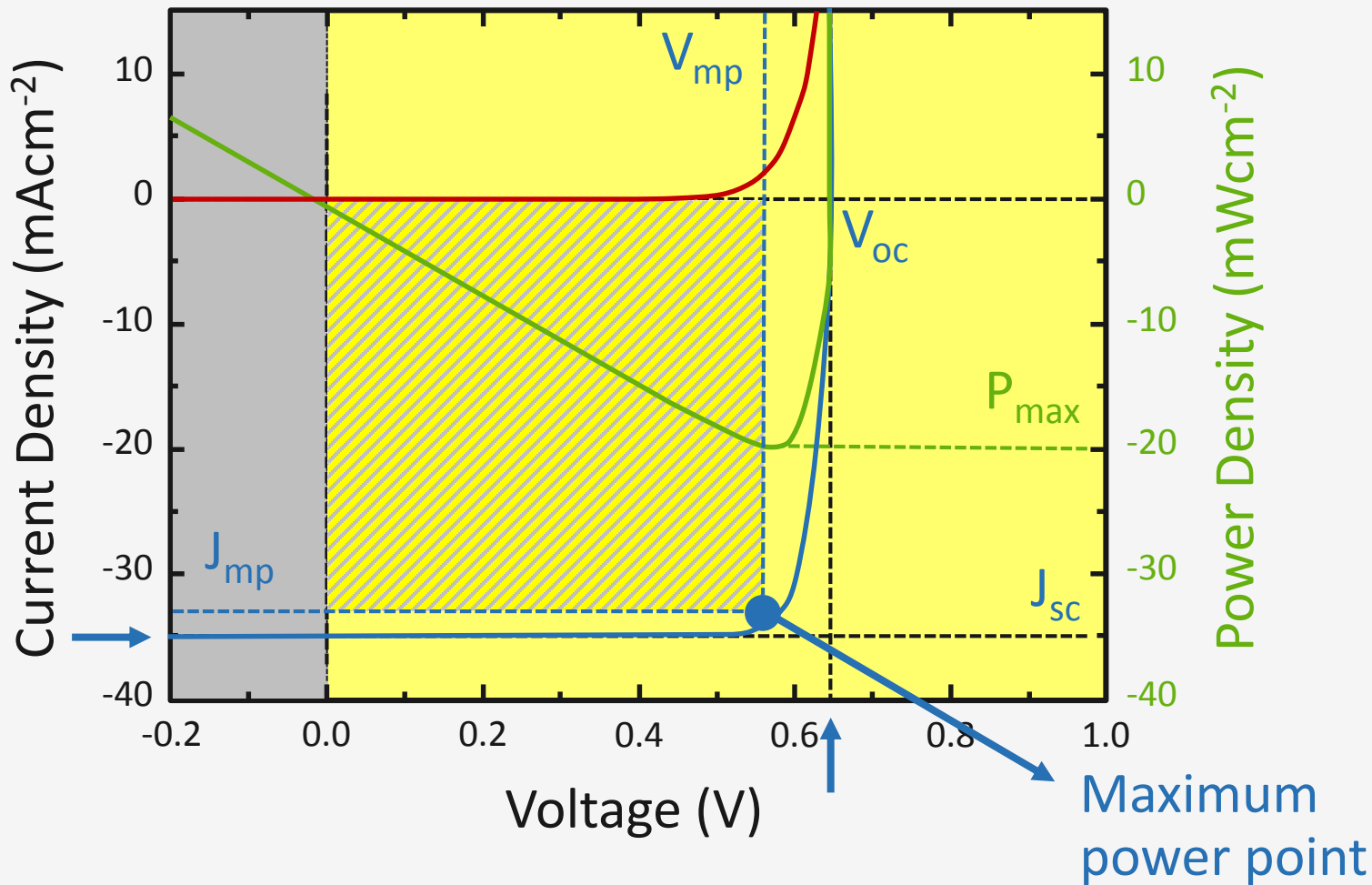


# Solar Cell Operation, Performance and Design Rules

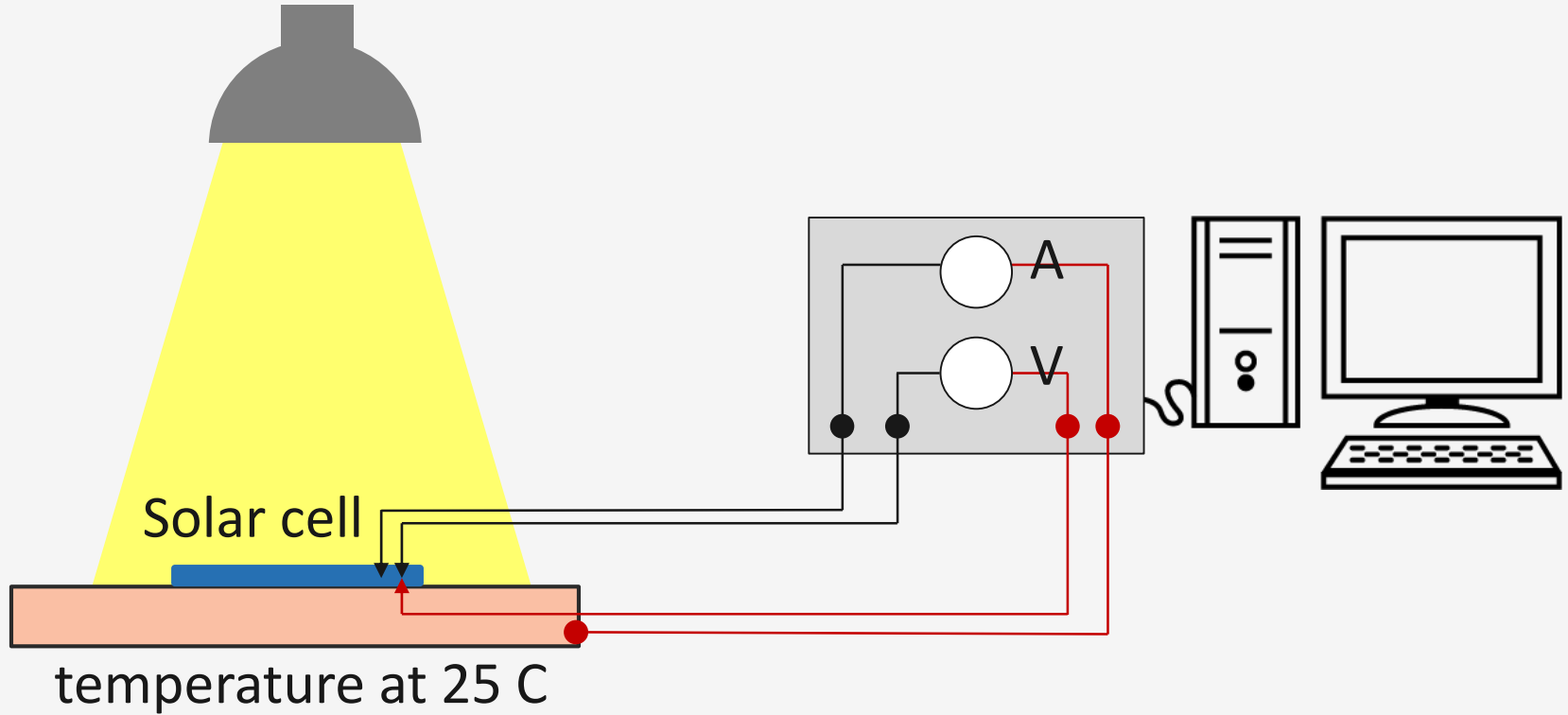
## Series and Shunt Resistance

*Week 3.2.2*

Arno Smets

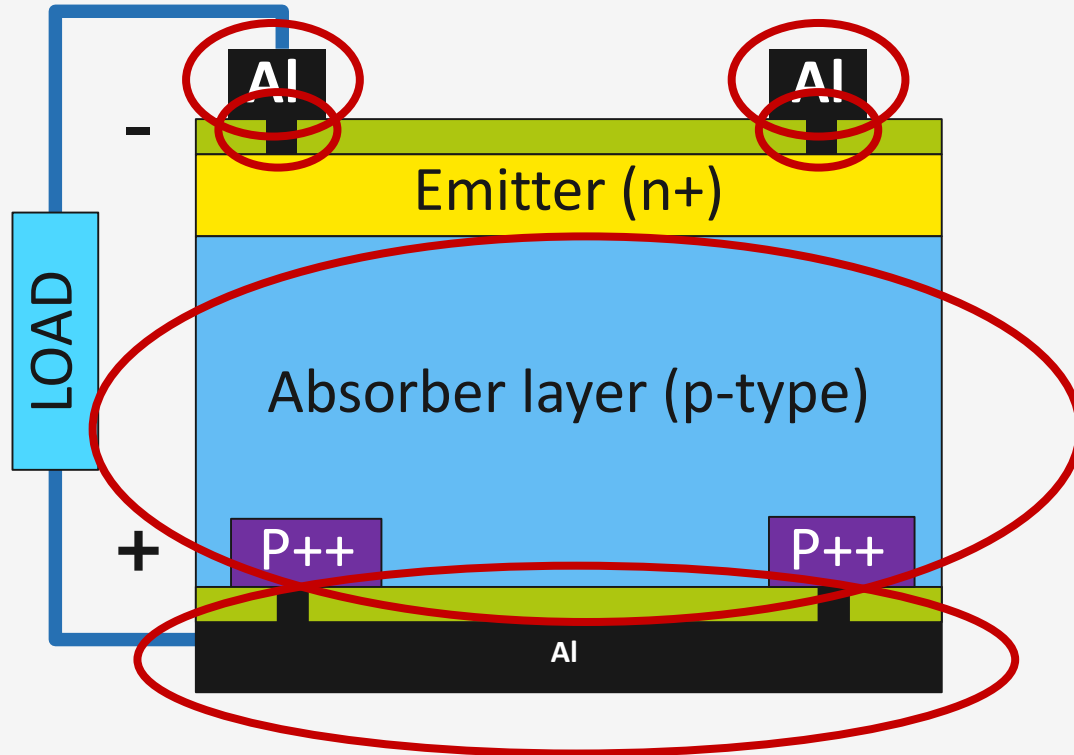


Air mass 1.5  
 $1000 \text{ W/m}^2$

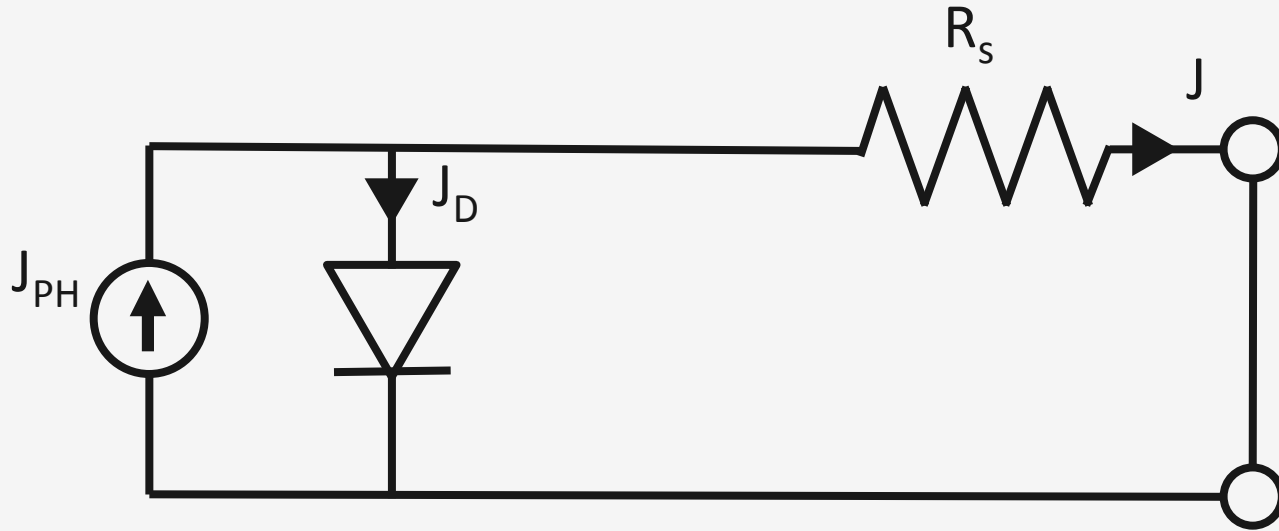




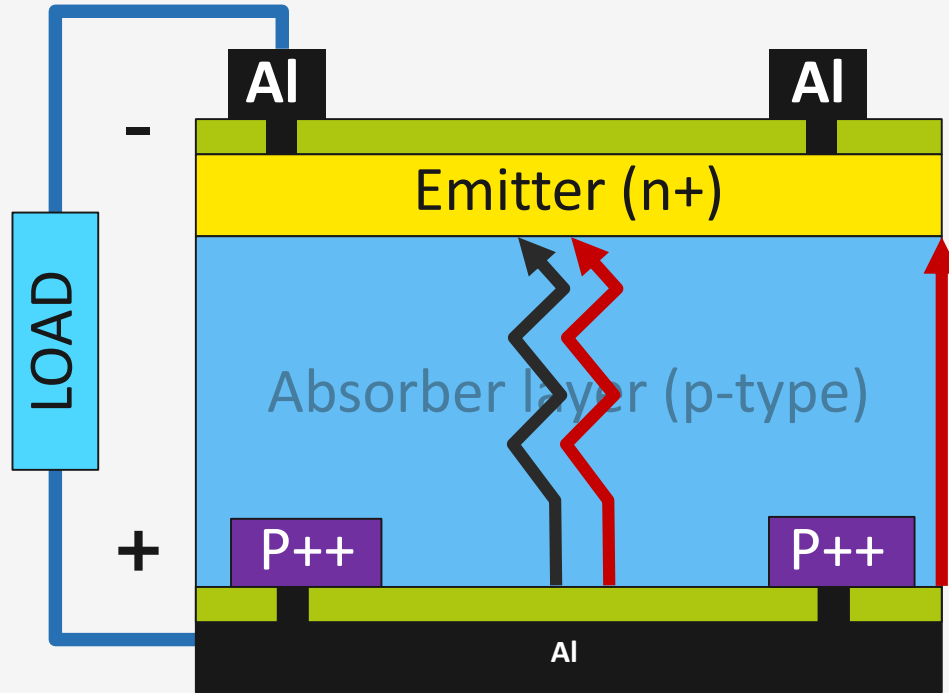
# JV-Characteristic: the Non Ideal Solar Cell



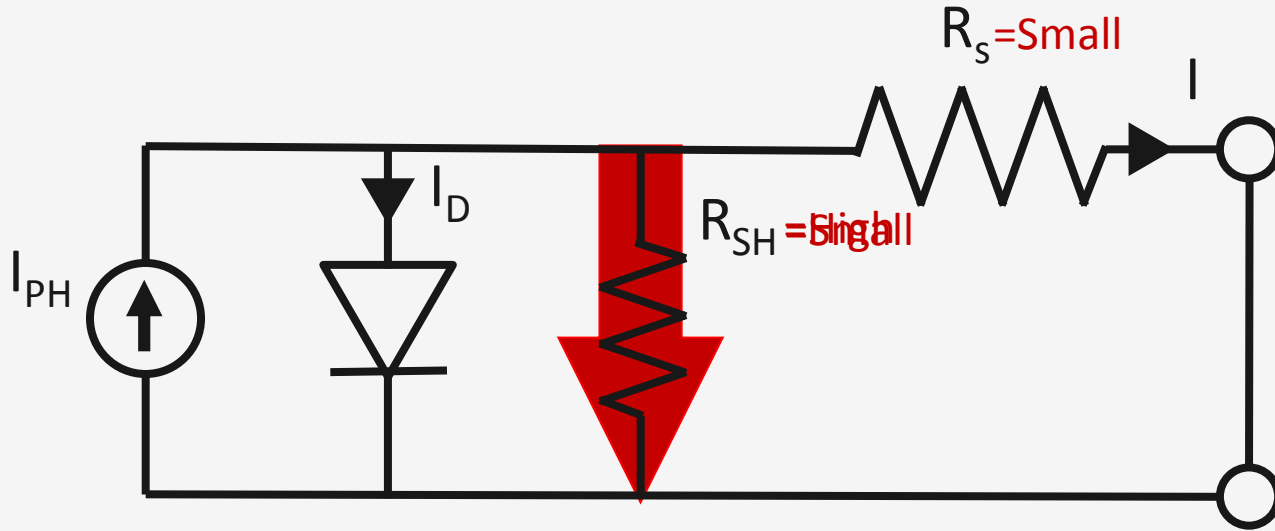
# JV-Characteristic: the external parameters



# JV-Characteristic: the Non Ideal Solar Cell

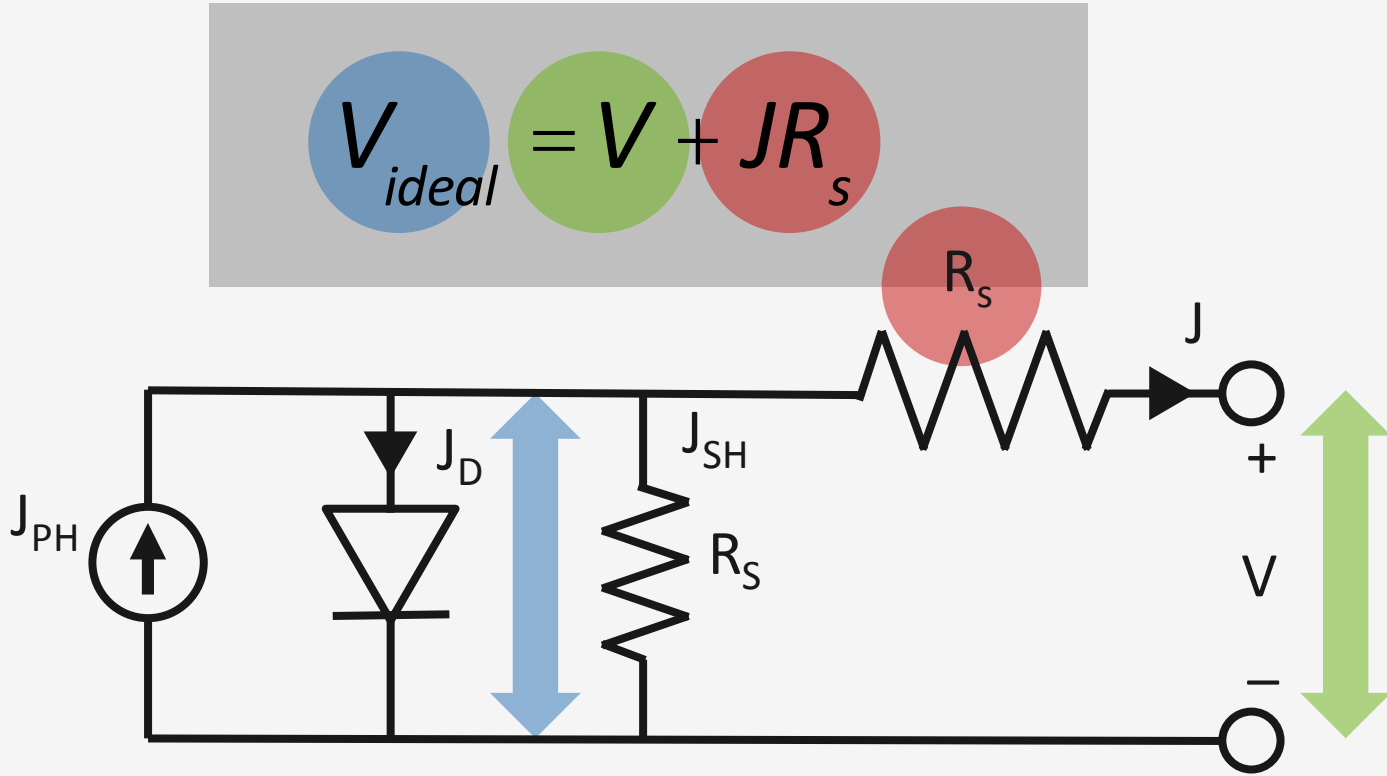


# JV-Characteristic: the Non Ideal Solar Cell



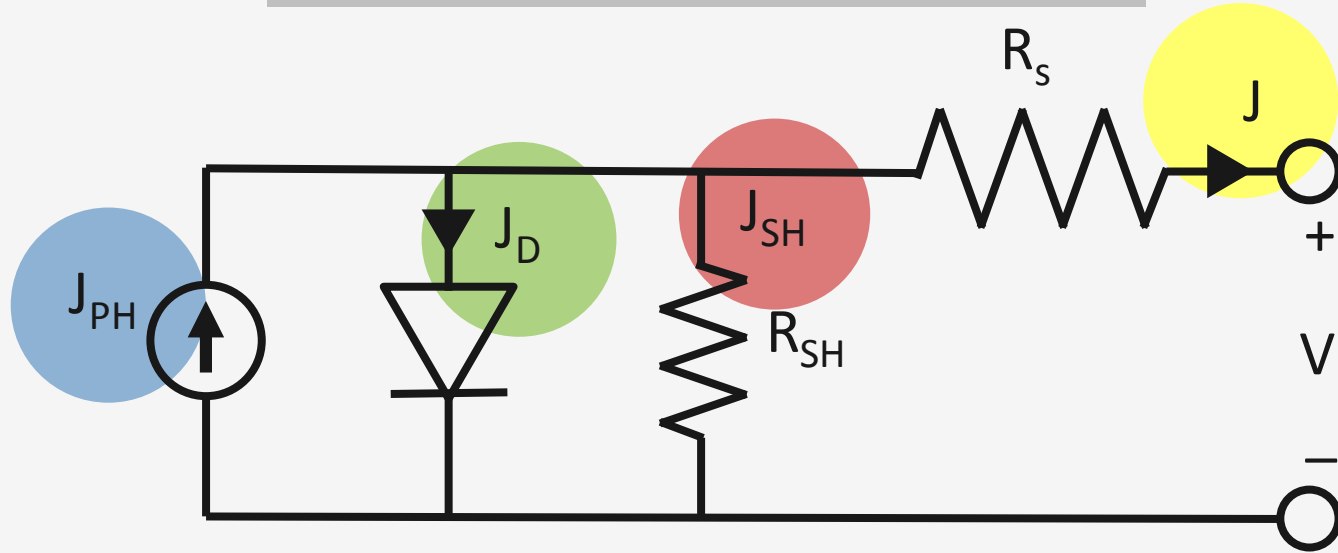


# JV-Characteristic: the external parameters

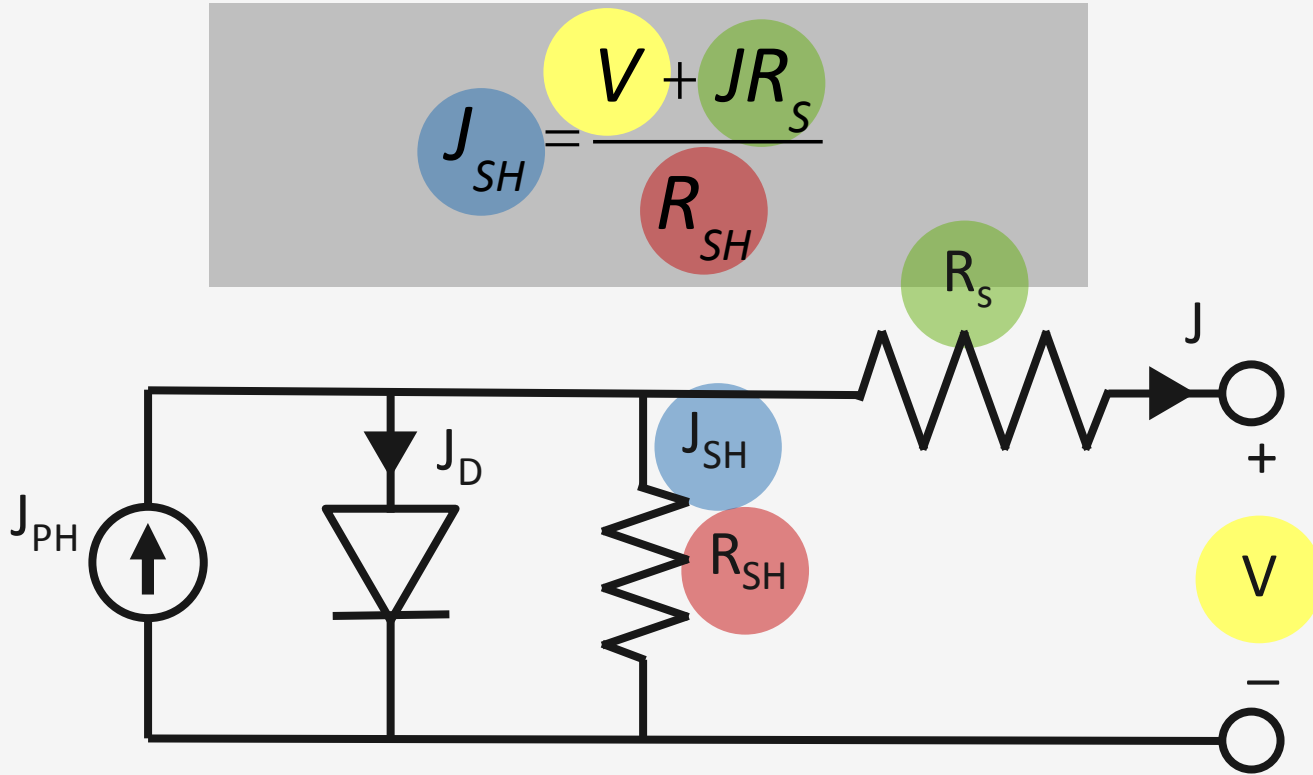


# JV-Characteristic: the external parameters

$$J = J_{PH} - J_{DARK} - J_{SH}$$



# JV-Characteristic: the external parameters

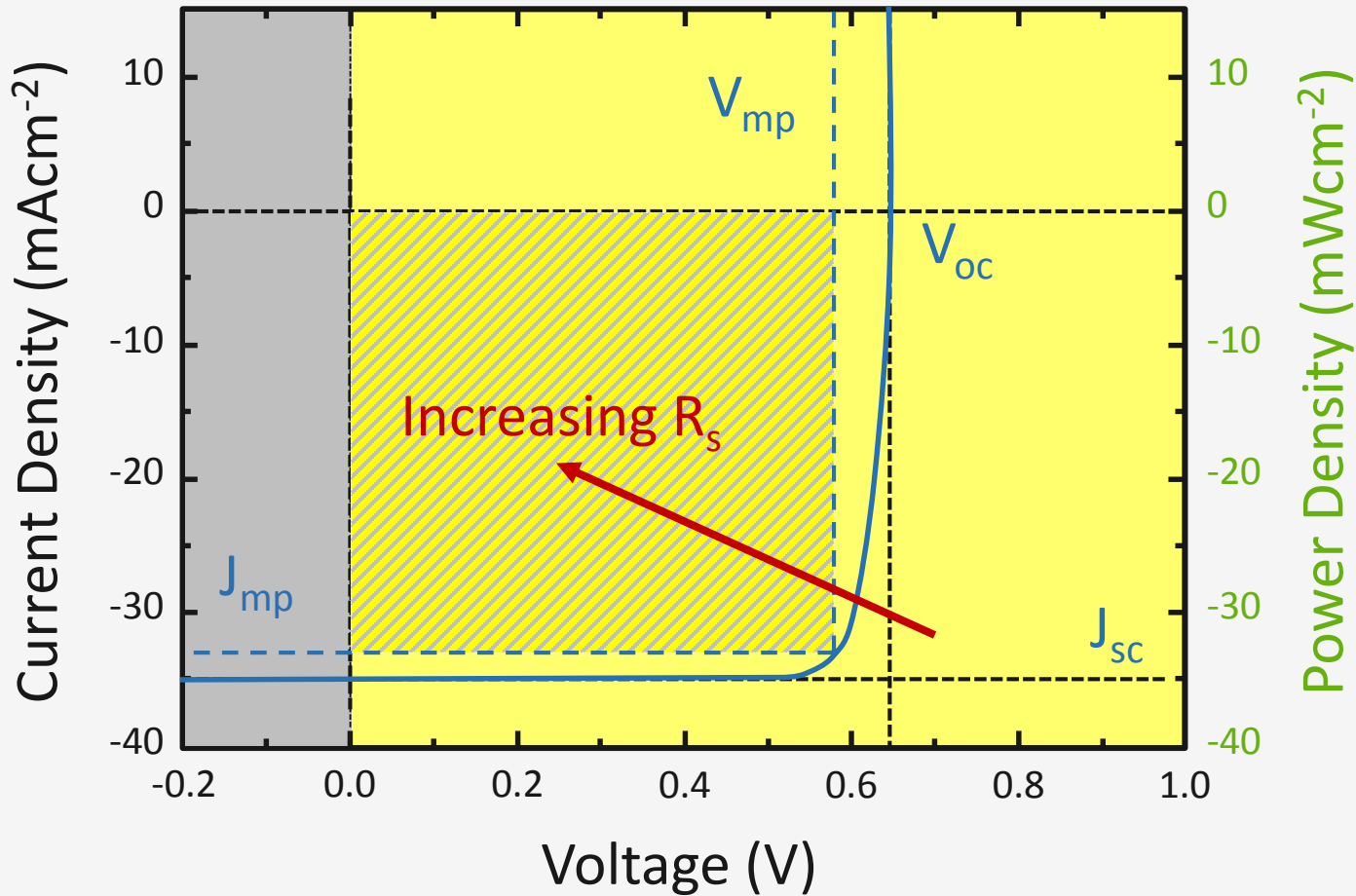


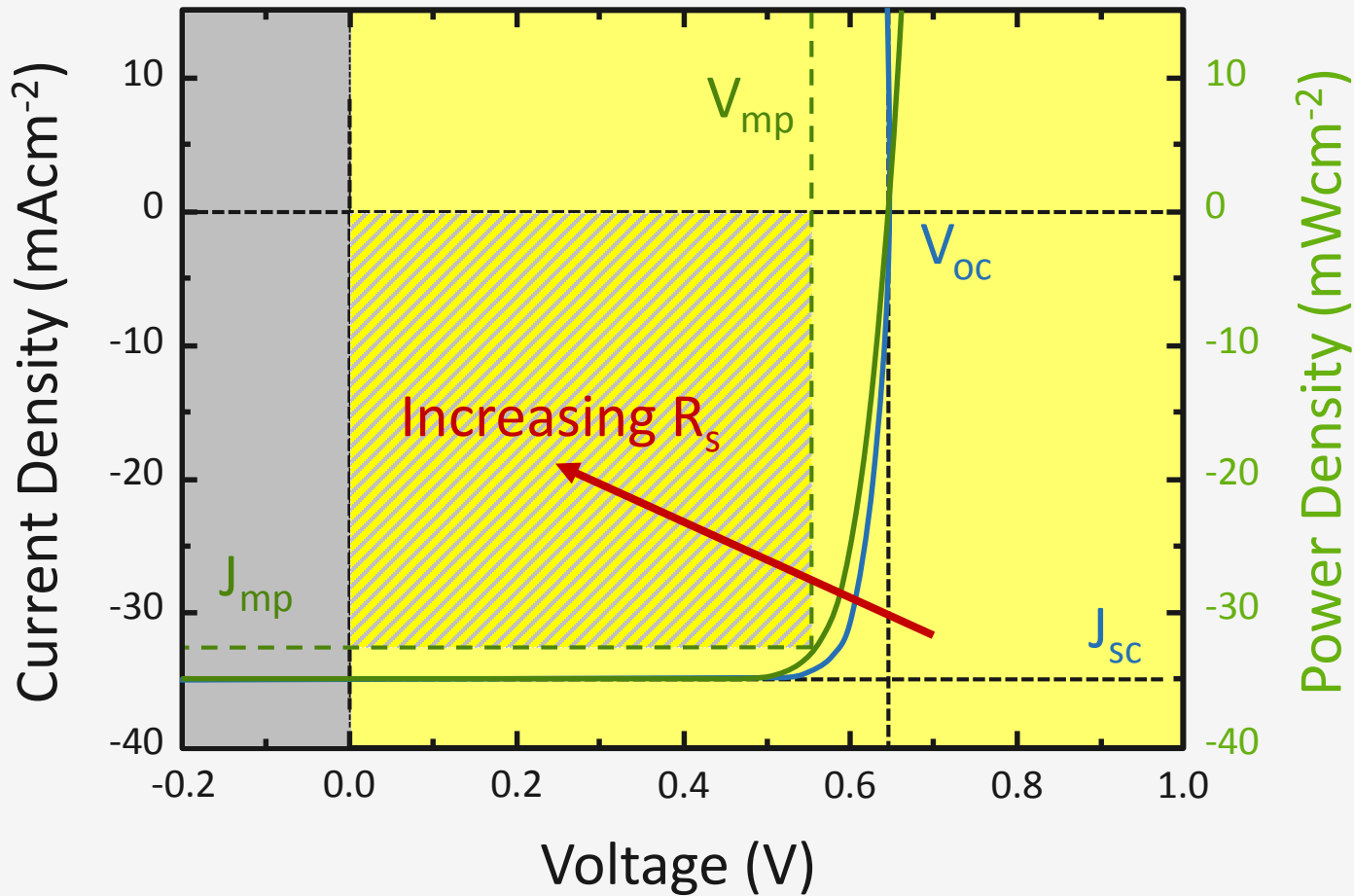
# JV-Characteristic: the external parameters

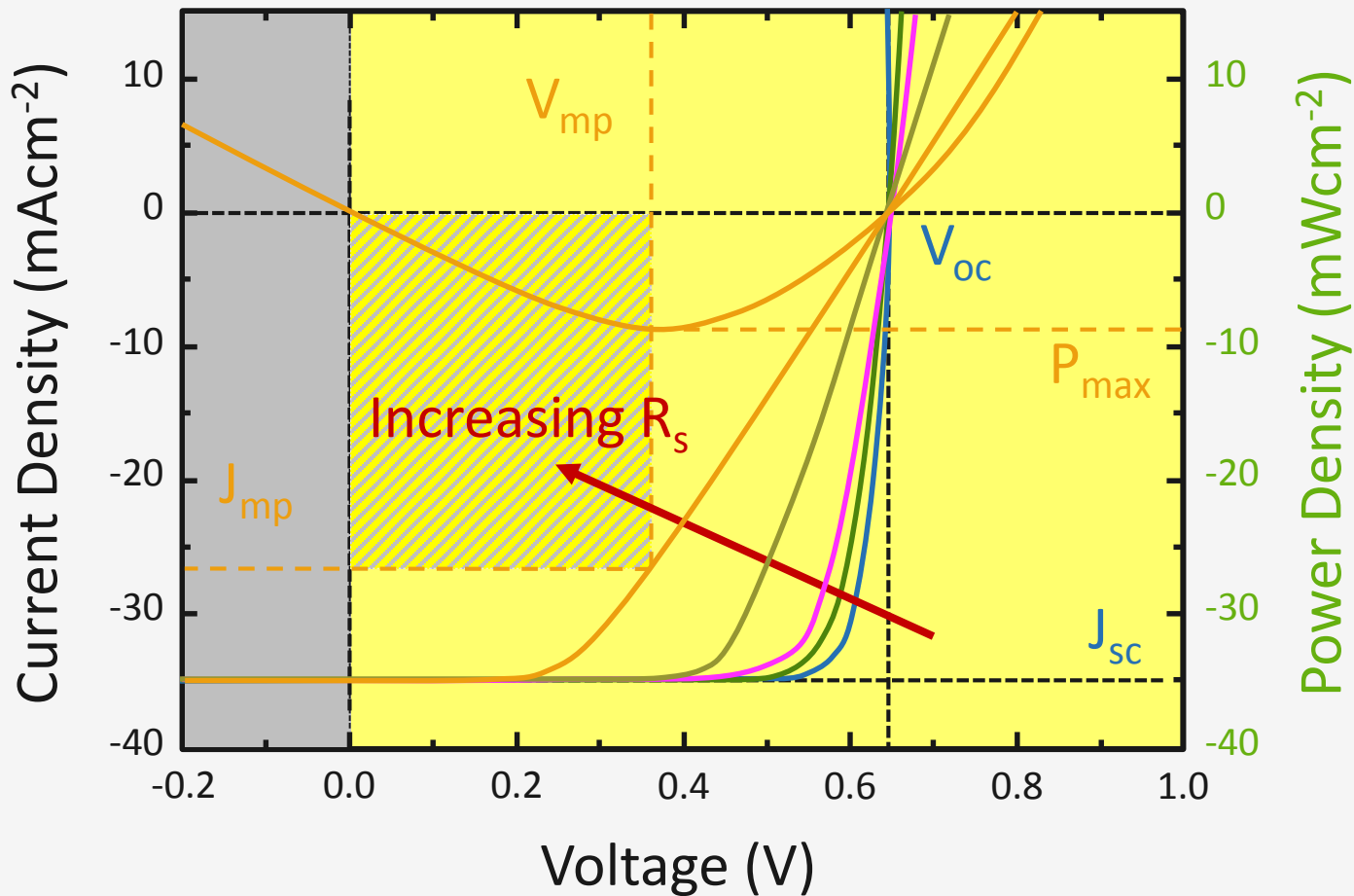
$$V_{ideal} = V + JR_s \quad \text{and} \quad J_{SH} = \frac{V + JR_s}{R_{SH}}$$

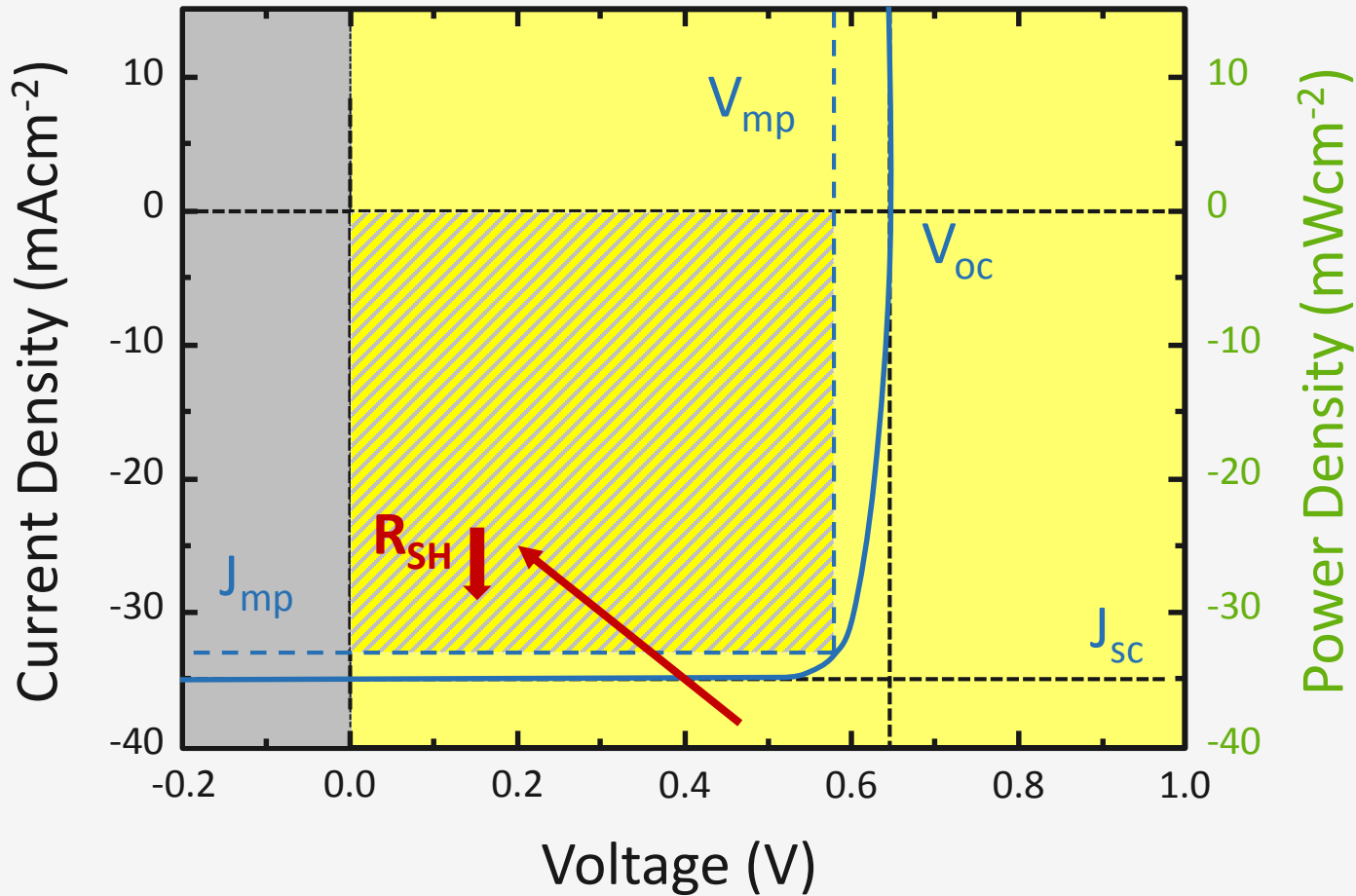
$$J = J_{PH} - J_{DARK} - J_{SH} =$$

$$J = J_{PH} - J_0 \exp\left(\frac{q(V + JR_s)}{k_B T}\right) - \frac{V + JR_s}{R_{SH}}$$

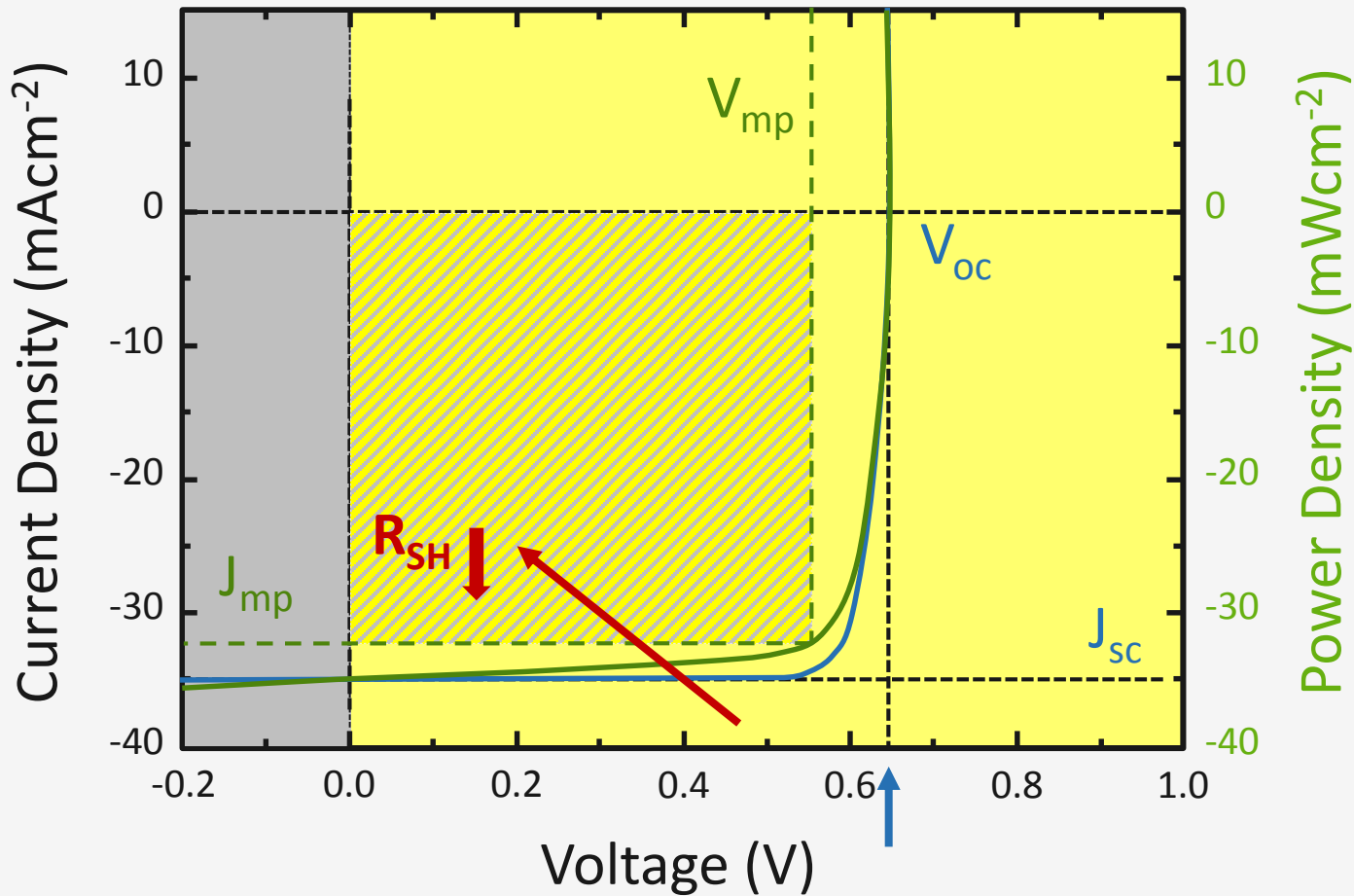


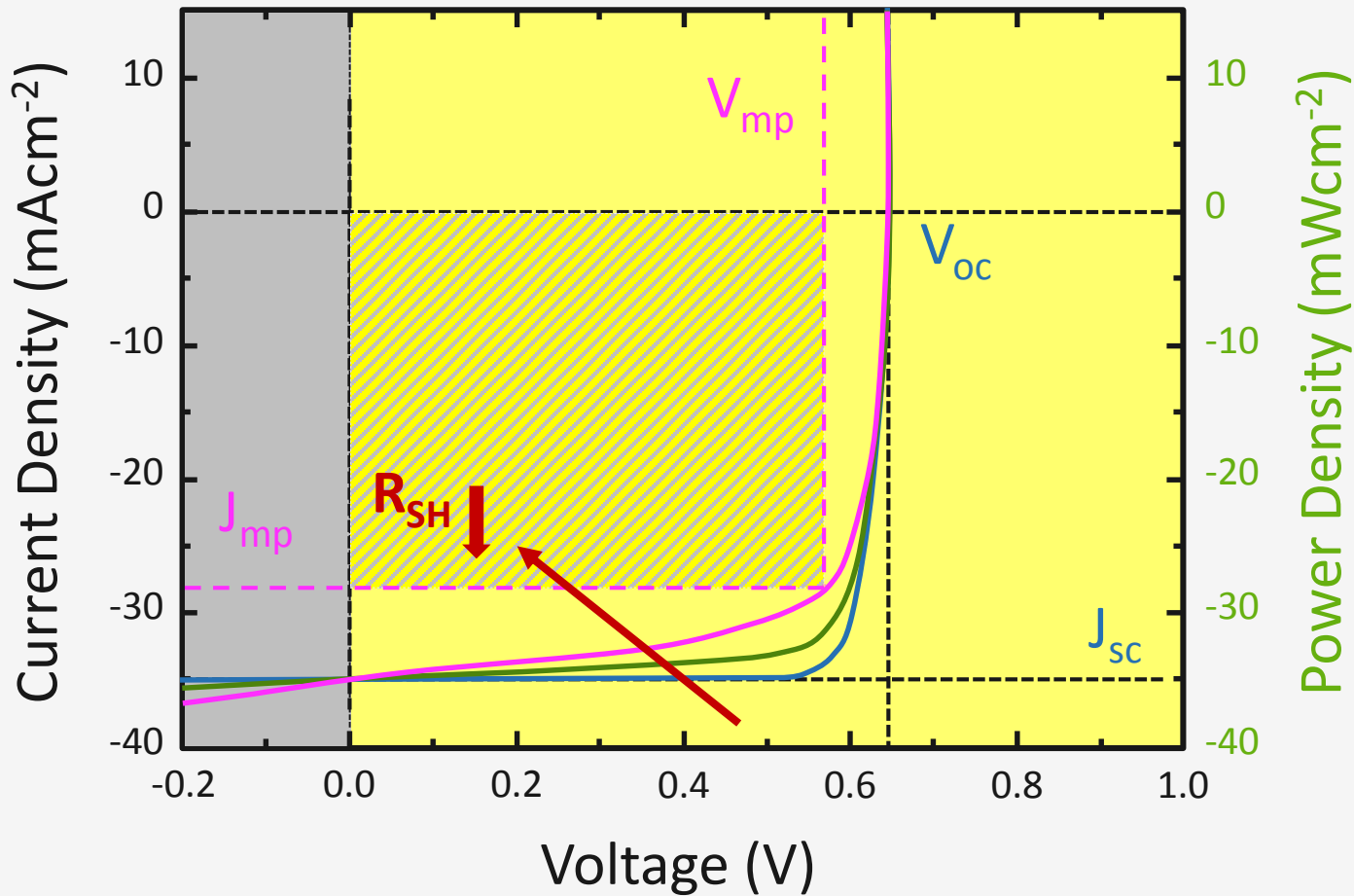


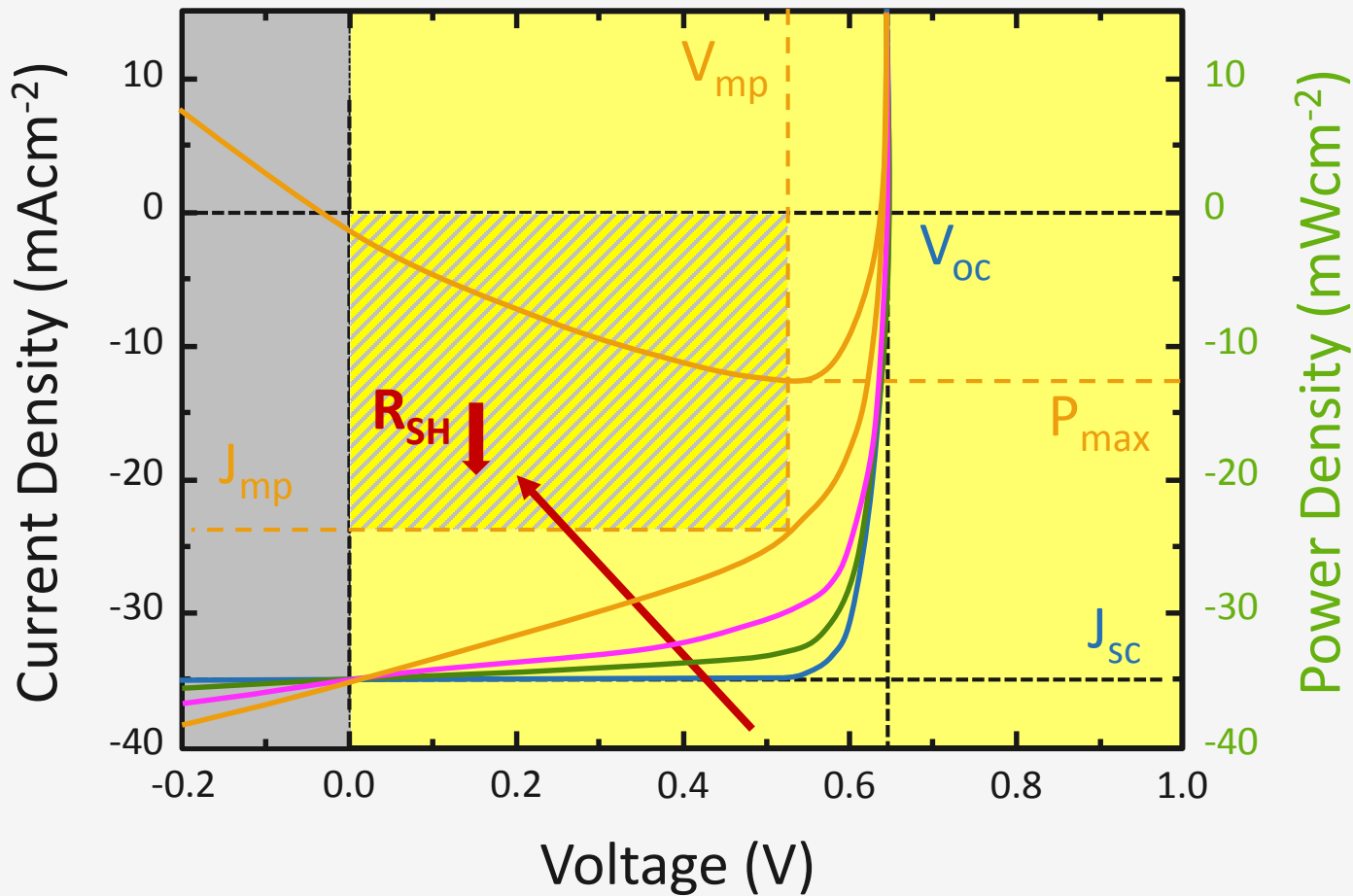


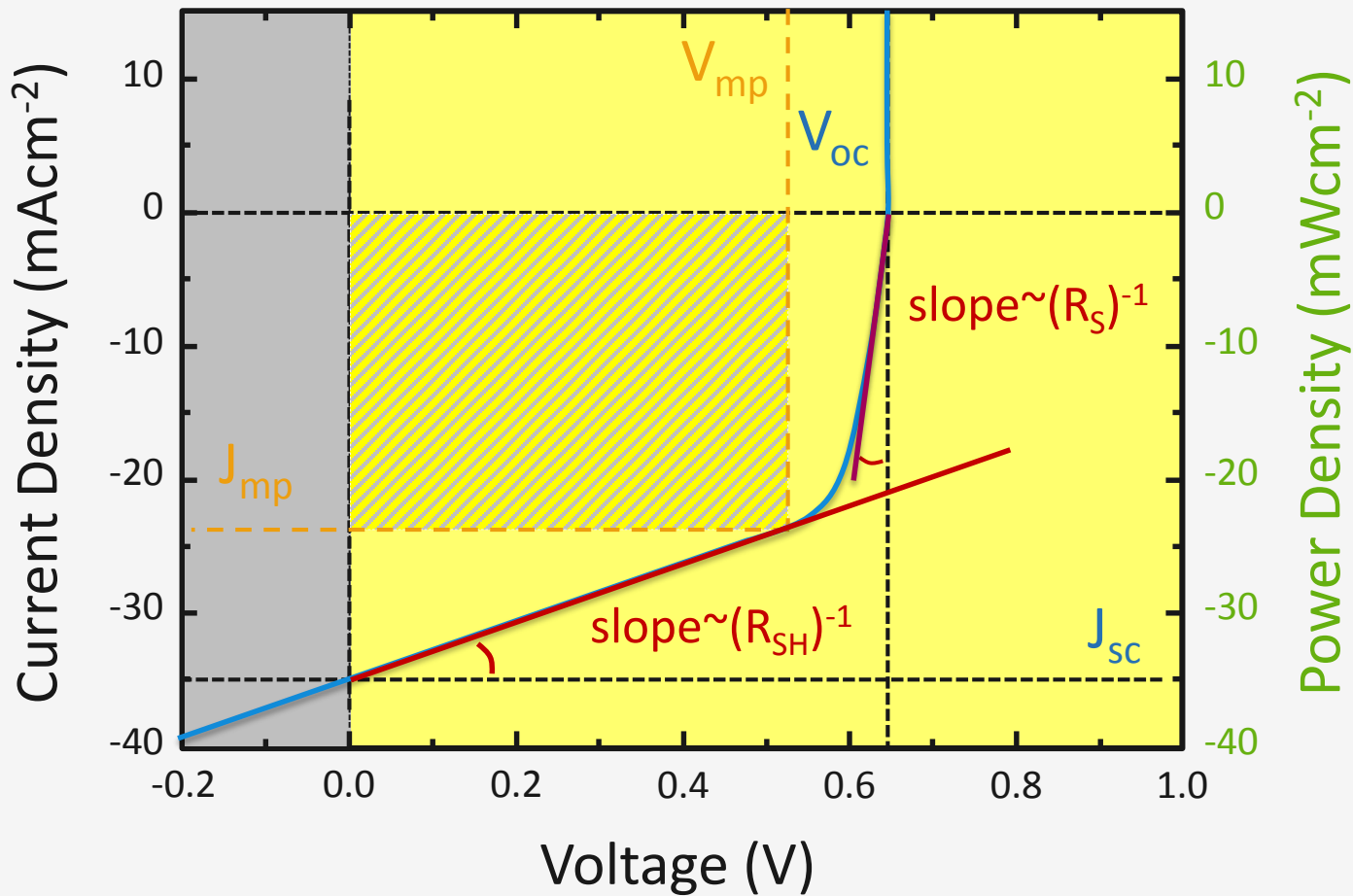


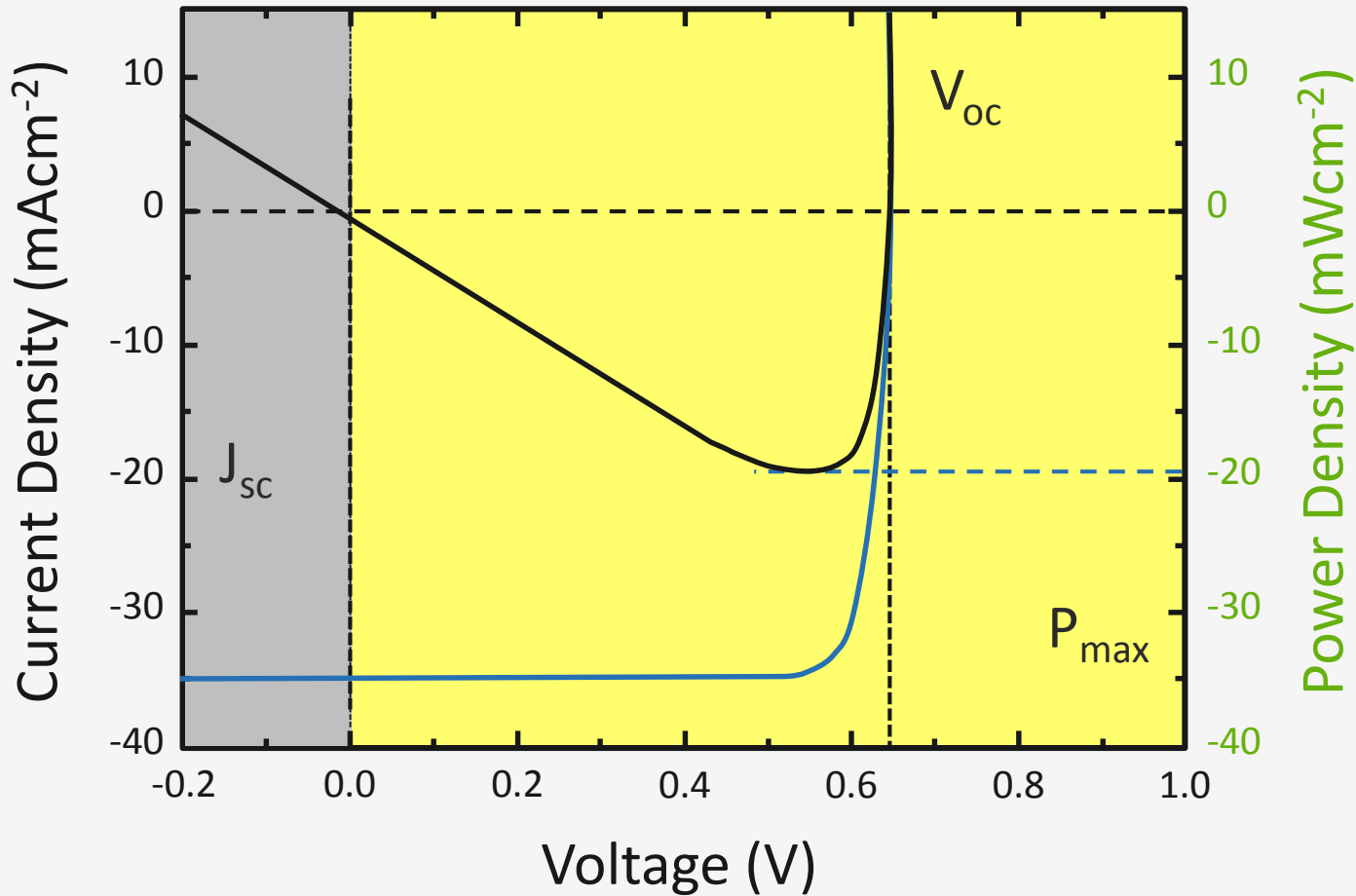




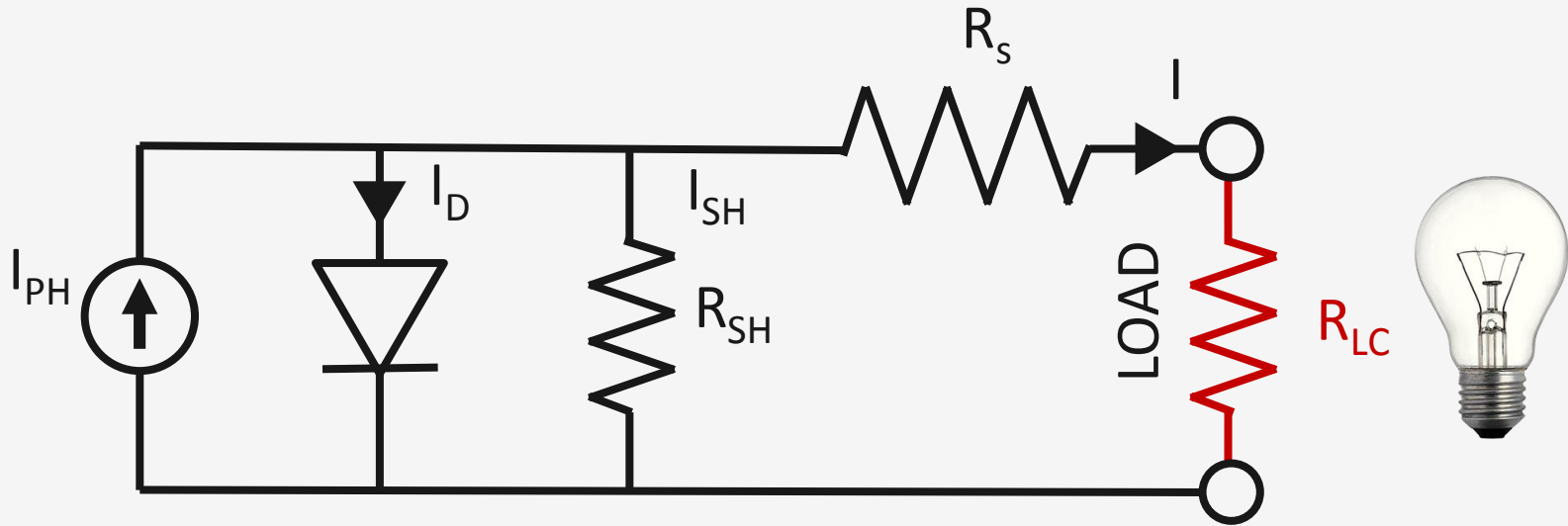


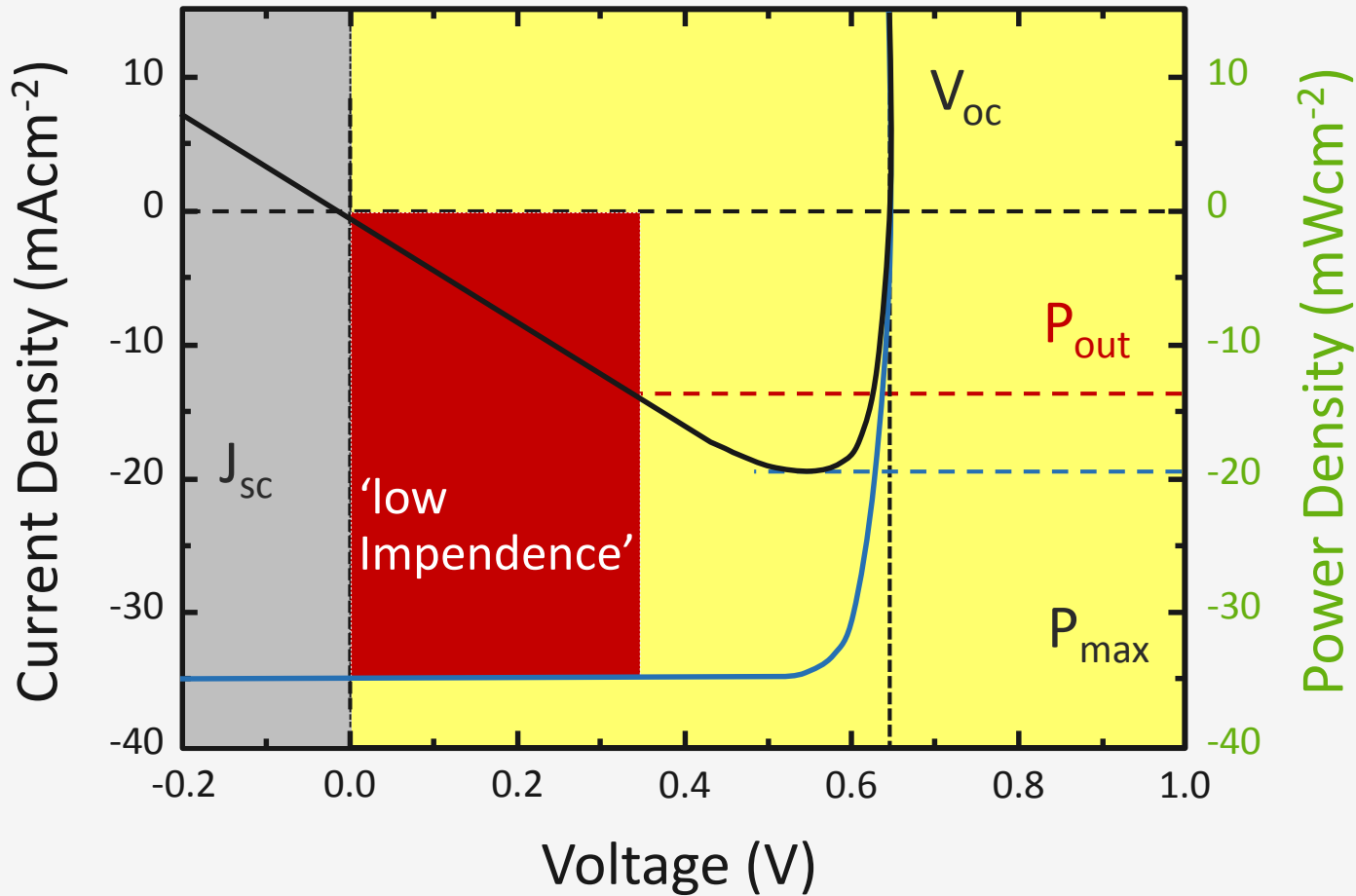


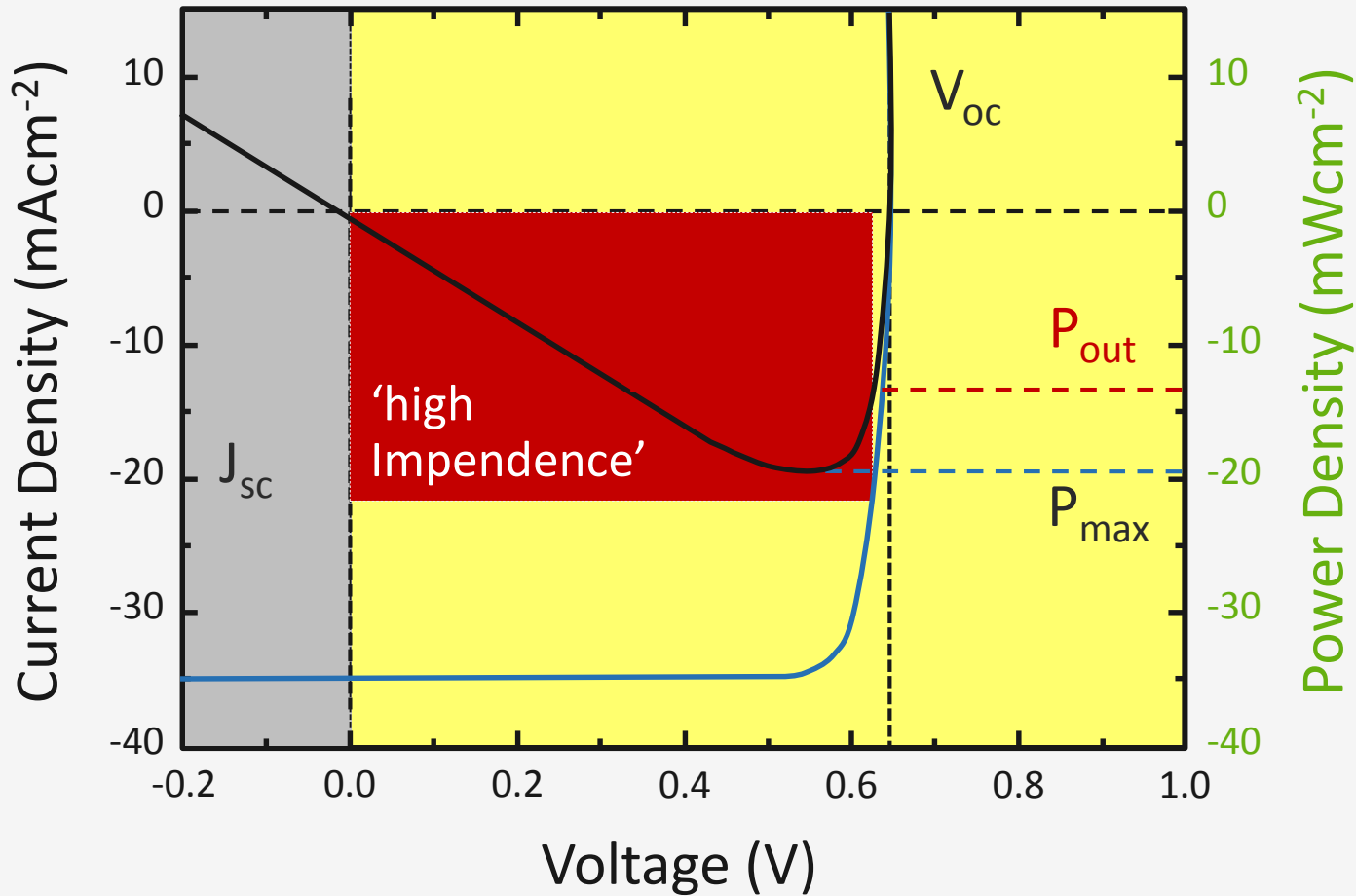




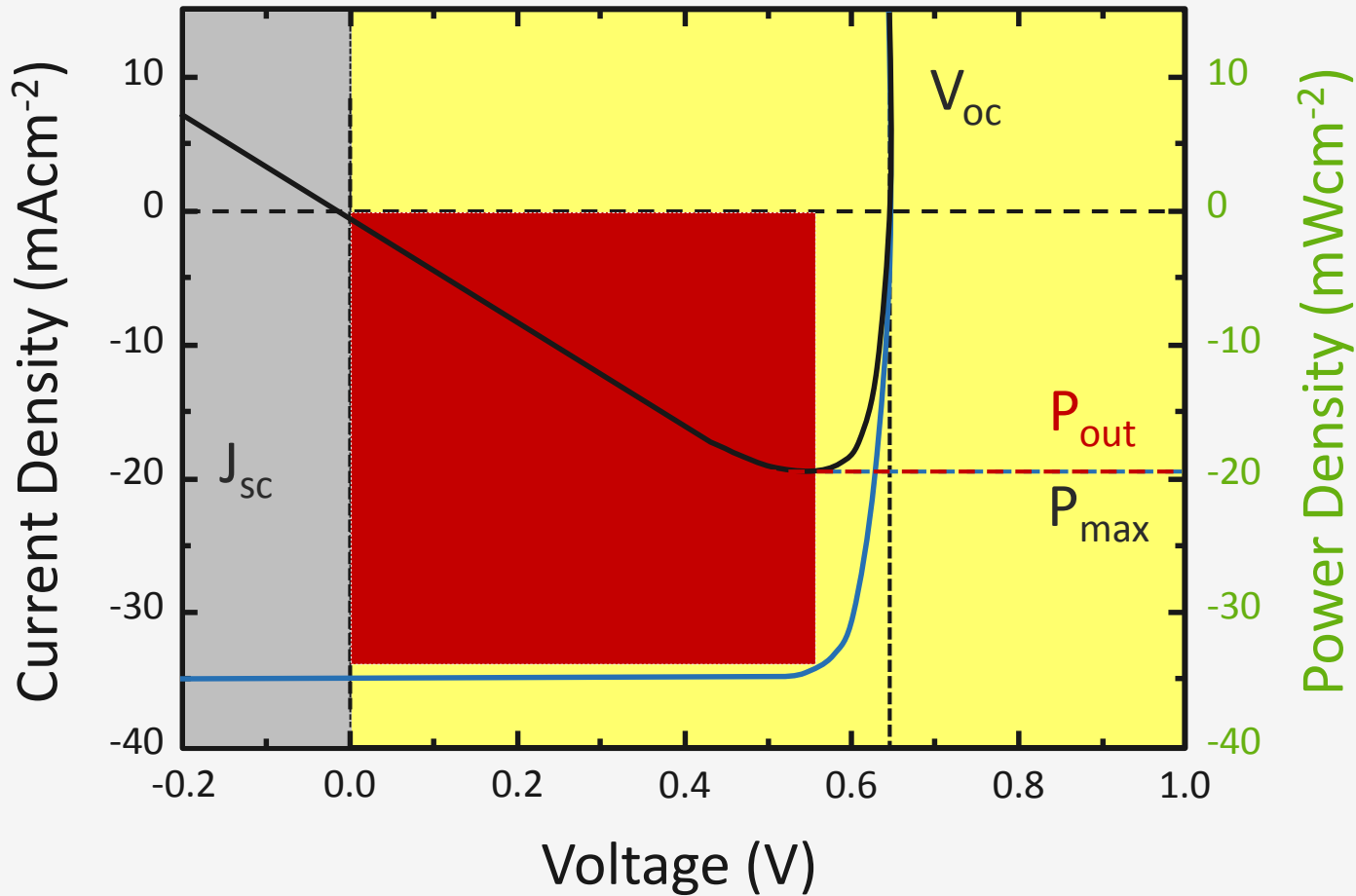
# JV-Characteristic: the effect of light intensity











**Thank you for your attention!**