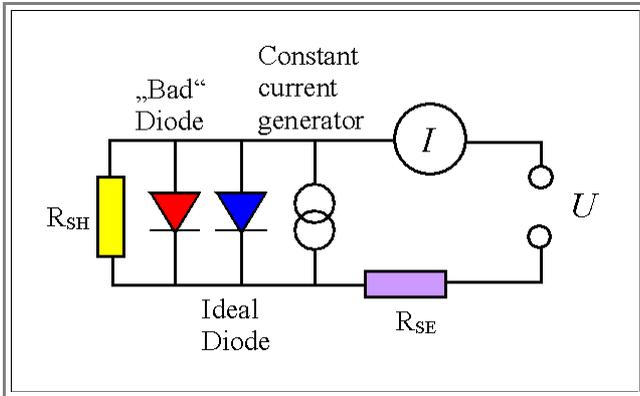


## Exercise 8.1-3

### IV Characteristics of Real Solar Cells

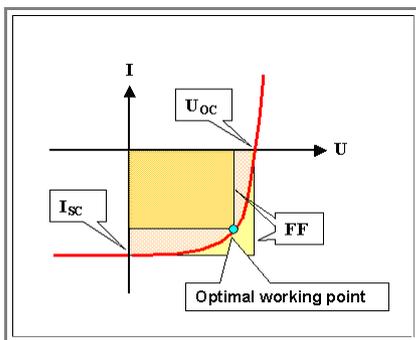
Let's consider a solar cell as described in the backbone, with a built in **series resistance**  $R_{SE}$  and a **shunt resistance**  $R_{SH}$



- We have the equivalent circuit diagram as shown.
- The shunt resistance takes into account that the huge area of the **pn-junction** of a solar cell might have weak points (locally, e.g. at the edge) which short-circuits the junction somewhat. These defects are summarily described by a **shunt resistor**.
- The constant current source mimics the current generated in the junction by light. It simply defines a current value  $I_{ph}$  (not to be mixed up with the terminal current  $I$ ) that is given by the light and added (with a negative sign) to the junction current, i.e.  $I_{\text{junct}} = I_{\text{diode}}(U) - I_{ph}$ . The photo current  $I_{ph}$  thus simply moves the total characteristics of the diode downwards on the current scale.

Take the following schematic curve of the **I-U**-characteristics as a reference and for the definition of the following terms:

- The **fill factor** is the relation between the area of the large yellow rectangle to the more orange area centered at the **optimal working point**.



Discuss qualitatively the influence of the **two resistors** (and, as a more minor point, the **ideality factor  $n$** ) on the **IV** characteristics with particular respect to:

- The **open-circuit voltage**  $U_{OC}$ .
- The **short-circuit current**  $I_{SC}$ .
- The **reverse dark current** if the solar cell is biased in the reverse direction.
- The **fill factor**  $FF$  (the degree of "rectangularism" of the characteristics).
- The **efficiency**  $\eta$  which is proportional to  $U_{OC}$ ,  $I_{SC}$ , and  $FF$ , i.e.

$$\eta = \text{const} \cdot U_{OC} \cdot I_{SC} \cdot FF$$

[Link to the solution](#)