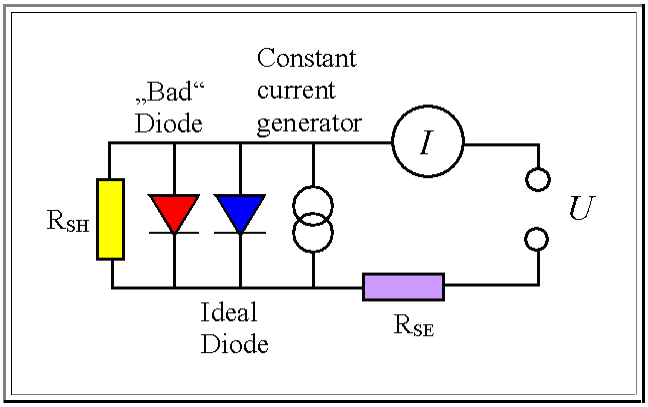
Exercise 8.1-3

IV Characteristics of Real Solar Cells

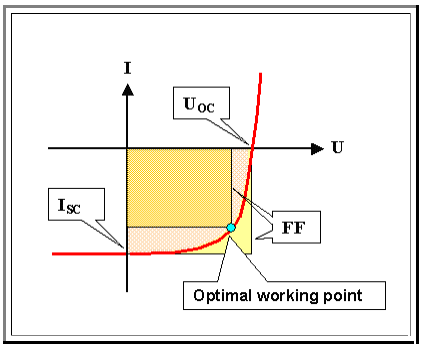
Lets consider a solar cell as described in the backbone, with a built in **series resistance** R_{SE} and a **shunt resistance** R_{SH}



- 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. $I_{junct} = I_{diode}(U) - I_{Ph}$. 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 *idealiy 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 bisased in the reverse direction.
- The **fill factor** ***FF*** (the degree of "rectangularism" of the characteristics).
- The **efficiency** η 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