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Intermediate band solar cells[1]

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Intermediate band (IB)solar cells aim to exploit the energy of below bandgap energy photons in solar cells. They are based in a material that, in addition to the conventional conduction and valence bands, have an electronic band (named intermediate band) located inside the bandgap and separated from the conduction and valence band by a null density of states. The theoretical limiting efficiency of these cells is equivalent to that of a triple junction solar cell (63.2% at maximum concentration) but requiring a single material instead. Several approaches are being followed worldwide to take to practice this concept. They can be classified into "bulk" or "quantum dot" approaches. In the "bulk" approach, the IB emerges from the insertion of impurities that can be incorporated inside the semiconductor at high densities (beyond the Mott's transition) without forming clusters and that typically would produce deep centers at low densities. Examples experimentally pursued worldwide under this approach are the following material systems: Si:Ti, InGaN:Mn, ZnTe:O and Cu(InGa)S2:Ti. In the "quantum dot" approach, the IB arises from the quantum confinement of the electrons usually in the conduction band. This system has allowed in the past to demonstrate some of the principles of operation of the IB solar cells on the basis mainly of the InAs/GaAs system. This system, however, is not optimum for IB solar cell operation and the challenge is now to find a feasible combination of materials that allow both to introduce the confined energy level at the appropriate position as well as to do it at the time the number of additional energy levels introduced between the intermediate band and the conduction band is minimized.

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