ELECTRICAL CHARACTERIZATION OF INTERMEDIATE BAND SOLAR CELLS

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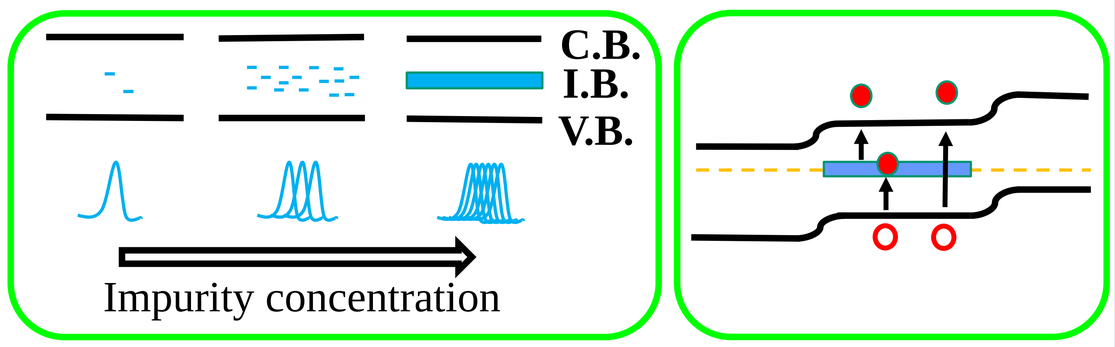
MOTIVATION

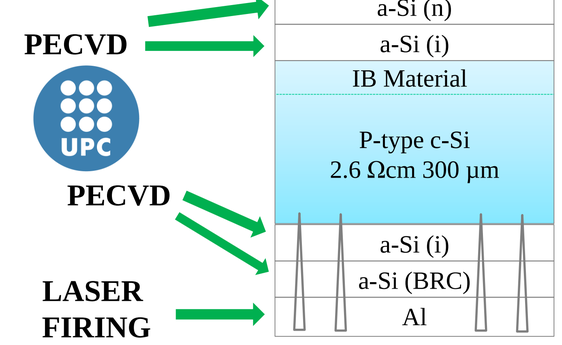
- Increase the sub-bandgap EQE in a silicon based solar cell.
- The **intermediate band** theory [1] predicts an increase of the optical absorption on this materials since a band of allowed states is created within the bandgap of the semiconductor.



- In this work we have fabricated and characterized different intermediate band solar cells (IBSC).

EXPERIMENTAL

Fabrication: Three different types of IBSC were fabricated [2,3].

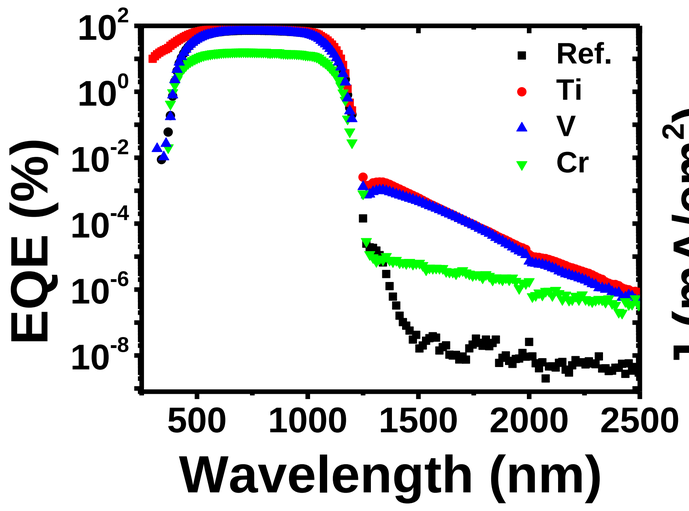


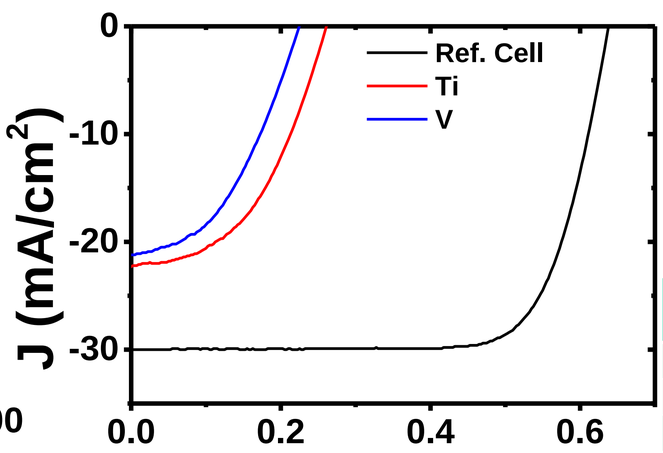
IB material: Si implanted with: **V, Ti or Cr** — 35 KeV, 10^{15} cm^{-2} + 150 KeV, $4 \cdot 10^{15}$ cm^{-2}

Pulse Laser Melting — 20 ns — 1.8 J/cm^2

RESULTS

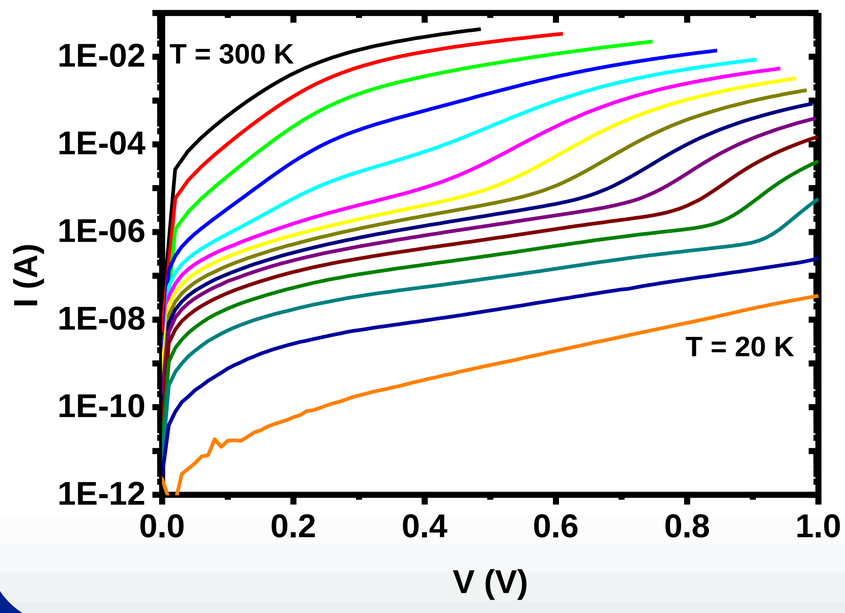
Sub-bandgap photo-response is observed up to wavelengths as high as 2500 nm for the intermediated band solar cells. We do not observe EQE in the reference cell in this range.



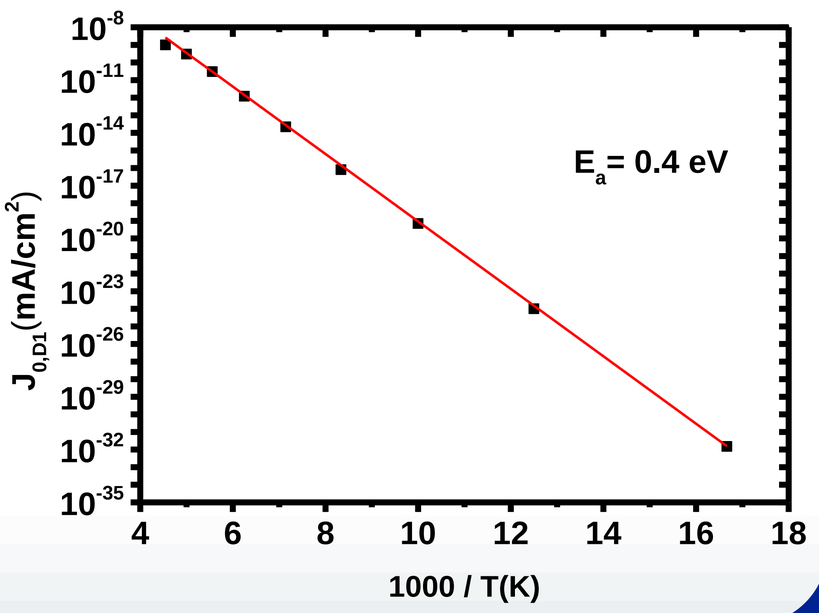


The J-V characteristics under illumination, shows photovoltaic effect for Ti and V cells, however the IBSC based on Cr has a degradation in the J-V.

	J_{sc} A/cm^2	V_{oc} (V)	FF (%)	Eff (%)
Ref.	30.01	0.638	75.04	14.36
Ti	22.24	0.261	47.27	2.74
V	21.22	0.225	43.51	2.05



Three different transport mechanisms are observed in the J-V characteristics. We associate two of them with tunnel processes with different activation energies. The third process only occurs at high temperatures, and we relate it with usual diffusion/ recombination in solar cells.



CONCLUSIONS

- ✓ **In this work we have fabricated different intermediate band solar cells and we characterized it. The J-V curves shows three different conduction mechanisms in these cells.**
- ✓ **We have obtained sub-bandgap external quantum efficiency (EQE) that could be related with an intermediated band situated between the conduction and the valence band, proving the potential of this material for photovoltaic applications.**

REFERENCES

[1] A.Luque and A. Marti; *Physical Review Letters*, vol. 78, pp. 5014-5017, Jun 30 1997.
[2] J. Olea, D.Pastor, I.Mártil, G.González-Díaz; Solar Energy Materials & Solar Cells 94 (2010) 1907–1911
[3] A. Morales, C. Voz, M. Colina, G. López, I. Martín, A. Orpella, J. Puigdollers, M. García, and R. Alcubilla, 2013 Spanish Conference on Electron Devices, (2013) 345–348.

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