

## Single-graded CIGS with narrow bandgap for tandem solar cells

Thomas Feurer \*, Benjamin Bissig, Thomas Paul Weiss, Romain Carron, Enrico Avancini, Johannes Löckinger, Stephan Buecheler and Ayodhya N. Tiwari

*Laboratory for Thin Films and Photovoltaics, Empa - Swiss Federal Laboratories for Materials Science and Technology, Ueberlandstrasse 129, 8600 Duebendorf, Switzerland*

\*corresponding author: Thomas Feurer, [thomas.feurer@empa.ch](mailto:thomas.feurer@empa.ch)

### Acknowledgements:

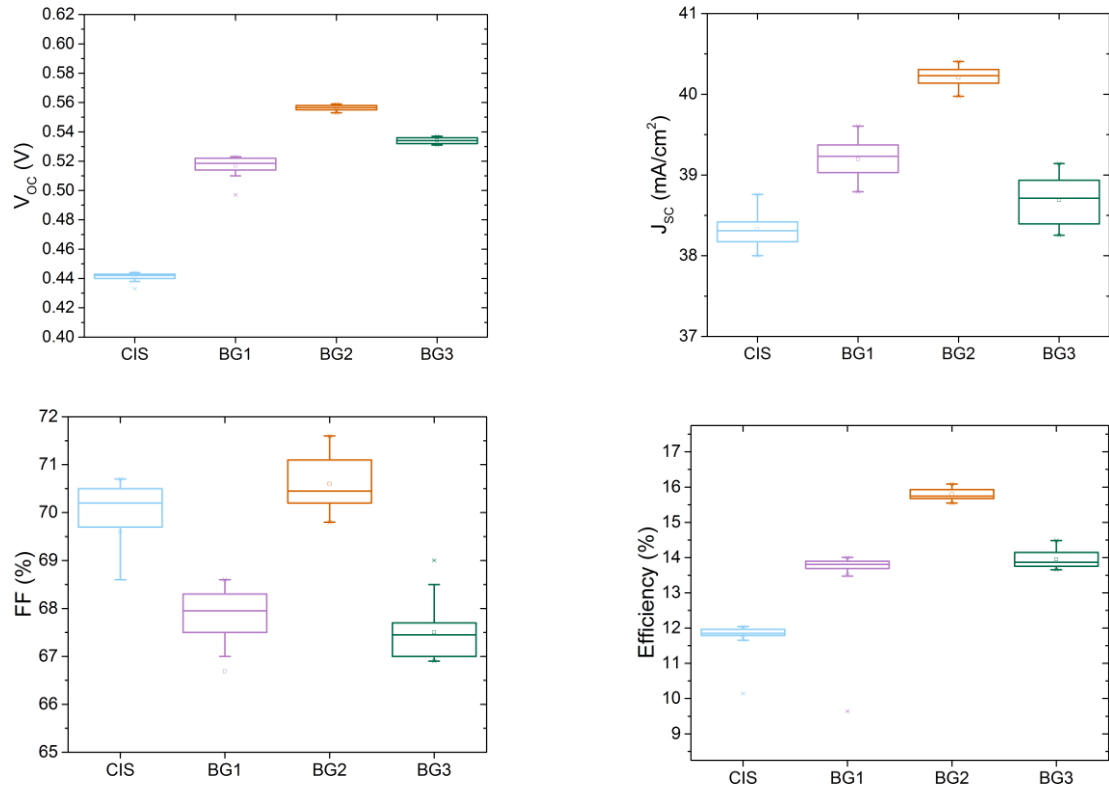
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### ORCID:

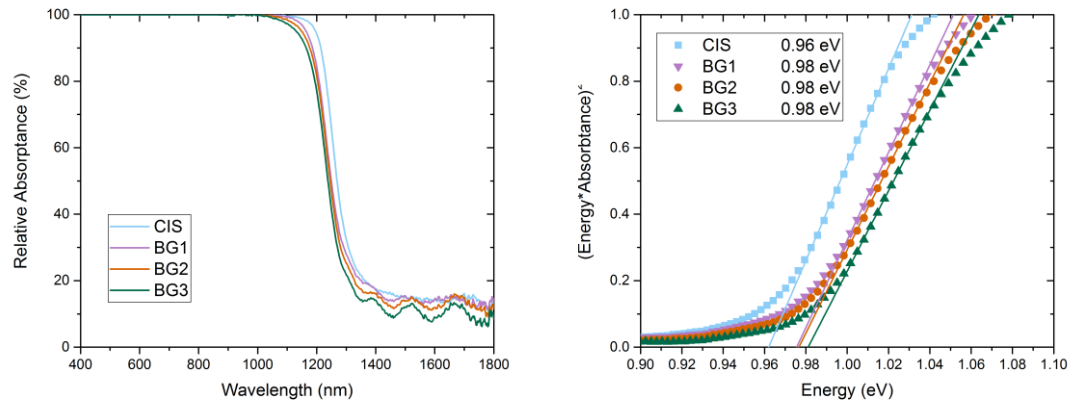
Thomas Feurer	0000-0002-0281-0176
Benjamin Bissig	0000-0001-9066-027X
Thomas P. Weiss	0000-0003-1823-4481
Romain Carron	0000-0001-8281-4881
Enrico Avancini	0
Johannes Löckinger	0000-0002-8154-3511
Stephan Buecheler	0
Ayodhya N. Tiwari	0

# Single graded CIGS with low band gap for tandem solar cells

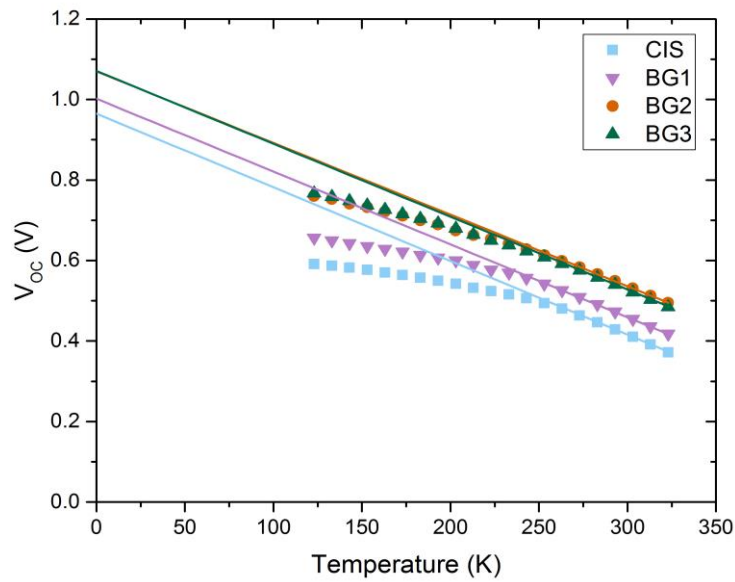
## Supplementary information



Supplementary Figure 1: JV- parameters of the samples with back grading in this work. Statistics over 18 cells each.



Supplementary Figure 2: Absorption of lifted of absorbers and representing bandgap extraction. The Absorption is extracted as  $1-T/(1-R)$ . The values do not reach 0 due to light-trapping inside the layer during the measurement.



Supplementary Figure 3:  $V_{OC}$ -T plot for the cells investigated in this experiment. The extrapolation of the linear region gives activation energies below bandgap for the non- or only weakly graded cells

## Tables

*Supplementary Table 1:* Fitting results of the IV curves presented in Fig. 1 using a one-diode model including series and parallel resistances.  $R_{s_{\text{illu}}}$  and  $R_{p_{\text{illu}}}$  is fitted on the illuminated curve and averaged over 16 or more cells while  $R_{p_{\text{dark}}}$ ,  $J_0$  and  $A$  are fitted on the dark  $JV$  curve.

	<b>GGI</b>	<b><math>R_{s_{\text{illu}}}</math> (<math>\Omega \text{ cm}^2</math>)</b>	<b><math>R_{p_{\text{illu}}}</math> (<math>\Omega \text{ cm}^2</math>)</b>	<b><math>R_{p_{\text{dark}}}</math> (<math>\Omega \text{ cm}^2</math>)</b>	<b><math>J_0</math> (<math>\text{mA cm}^{-2}</math>)</b>	<b><math>A</math> (-)</b>
<b>CIS</b>	0.00	0.33	510	4600	2.05E-5	1.24
<b>BG1</b>	0.04	0.23	460	1600	4.71E-5	1.54
<b>BG2</b>	0.06	0.35	1240	2800	5.42E-5	1.66
<b>BG3</b>	0.09	0.23	530	2500	1.19E-4	1.71