

ChemSusChem

Supporting Information

High Open-Circuit Voltage Cs₂AgBiBr₆ Carbon-Based Perovskite Solar Cells via Green Processing of Ultrasonic Spray-Coated Carbon Electrodes from Waste Tire Sources

Fabian Schmitz⁺, Nicolò Lago⁺, Lucia Fagiolari, Julian Burkhart, Andrea Cester, Andrea Polo, Mirko Prato, Gaudenzio Meneghesso, Silvia Gross, Federico Bella,* Francesco Lamberti,* and Teresa Gatti* This publication is part of a Special Collection highlighting "The Latest Research from our Board Members". Please visit the Special Collection at [.© 2022 The Authors.](#) ChemSusChem published by Wiley-VCH GmbH. This is an open access article under the terms of the Creative Commons Attribution Non-Commercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

Table of Contents

- Raman spectrum, thermogram and P-XRD pattern of the carbon powder prepared from waste tire sources (Figure S1)
- Scheme of the CE US deposition pattern on top of the FTO/TiO₂/Cs₂AgBiBr₆ architecture (Figure S2)
- GIXRD pattern of the FTO/TiO₂/Cs₂AgBiBr₆/CE C-PSC (Figure S3)
- SEM images of the FTO/TiO₂/Cs₂AgBiBr₆ architecture (Figure S4)
- DLS spectrum of the carbon ink in iPA used for US spray coating of the CE (Figure S5)
- Argon physisorption and calculated BET surface area for the carbon black powder (Figure S6)
- UV-visible absorption spectrum of the FTO/TiO₂/Cs₂AgBiBr₆ architecture (Figure S7)
- EQE spectra of a FTO/TiO₂/Cs₂AgBiBr₆/CE C-PSC before and after application of FTO on top of the CE (Figure S8)
- SEM cross-section images of C-PSCs based on screen-printed CEs (Figure S9)
- J-V characteristics for C-PSCs based on screen-printed CEs (Figure S10)

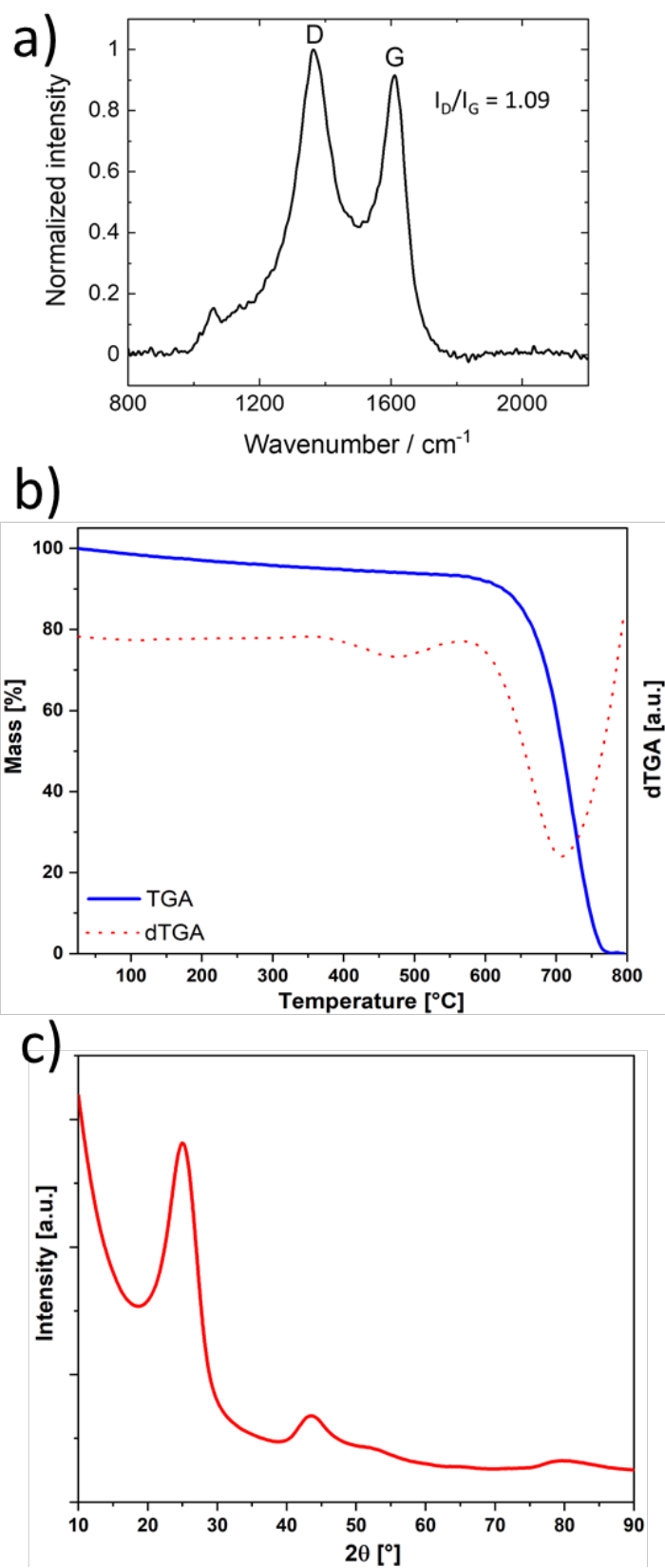


Figure S1. a) Raman plot, b) TGA thermogram and c) P-XRD trace for tire-derived carbon black.

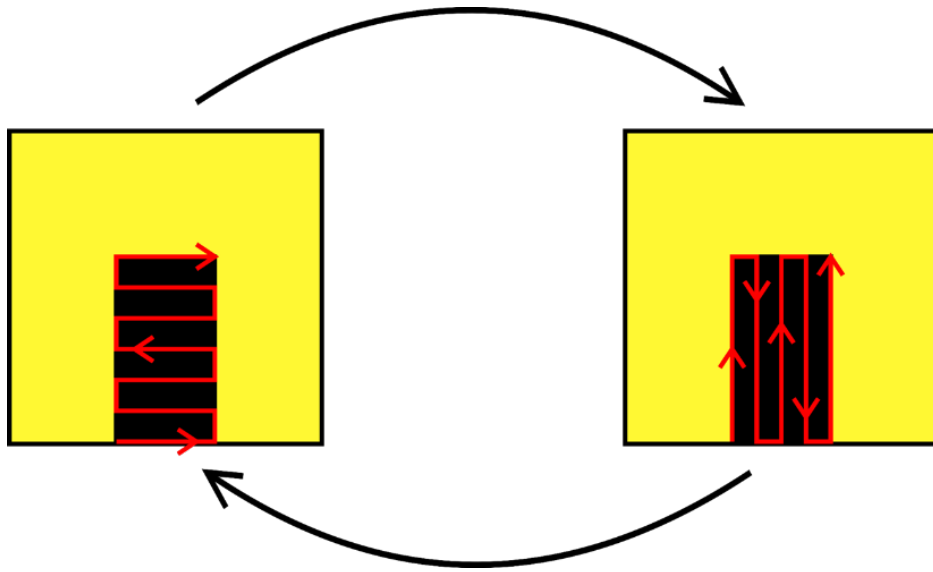


Figure S2. CE US deposition pattern on top of the FTO/TiO₂/Cs₂AgBiBr₆ direct PSC architecture.

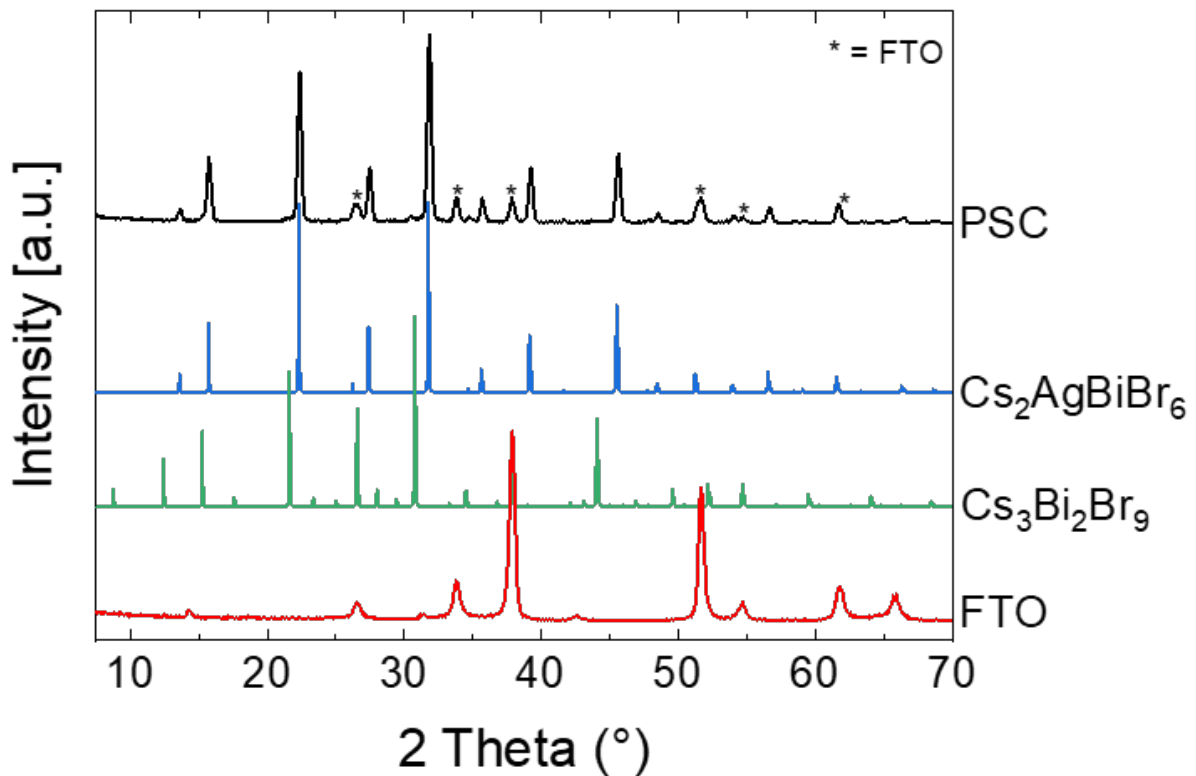


Figure S3. GIXRD pattern of the FTO/TiO₂/Cs₂AgBiBr₆/CE C-PSC. The measured GIXRD pattern for the FTO substrate and the theoretical patterns of the Cs₂AgBiBr₆ double perovskite and of the typical side-phase Cs₃Bi₂Br₉ are also reported for the sake of comparison, showing that no side phase is present (or at least detectable) in the solar cell architecture.

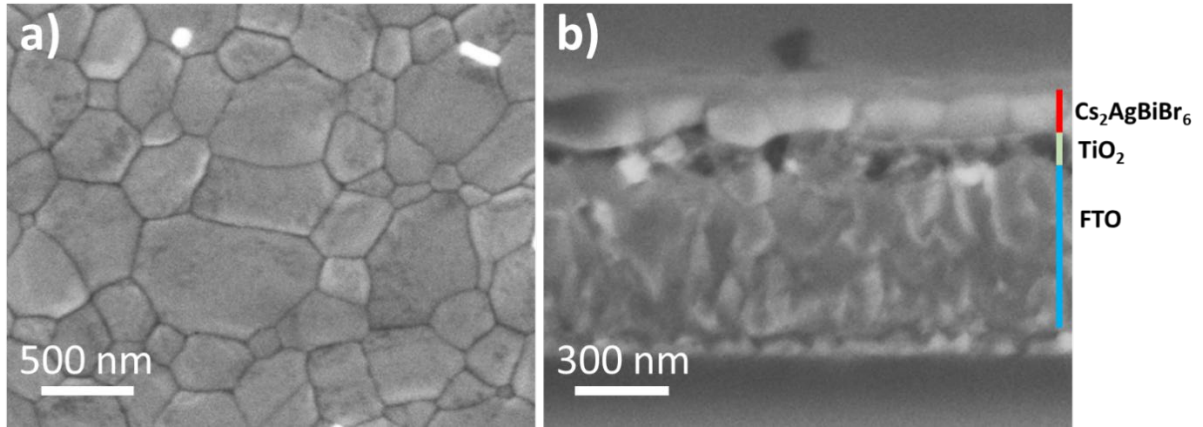


Figure S4. Top-view a) and cross-section b) SEM images of the $\text{Cs}_2\text{AgBiBr}_6$ double perovskite thin film processed on top of a FTO/compact TiO_2 substrate.

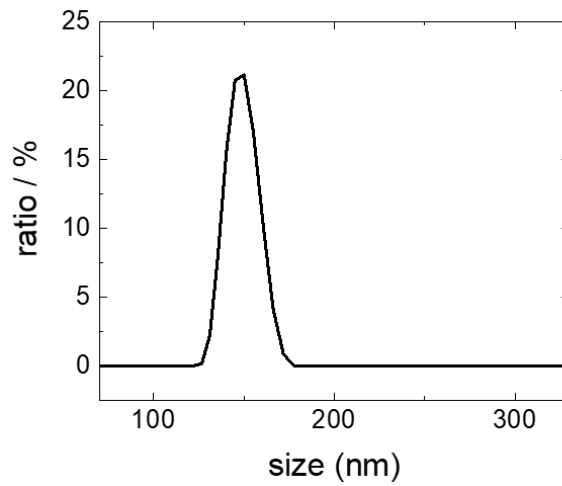


Figure S5. DLS spectrum of the 0.1 mg/mL carbon ink in iPA prepared after tip-sonication and used for US spray coating.

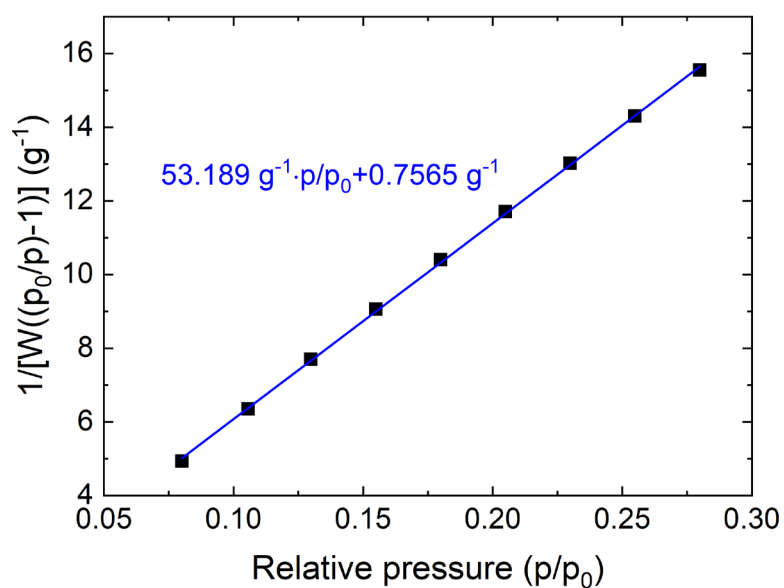


Figure S6. Argon physisorption measurements (black dots) and BET fit (blue) to calculate the specific surface area of the carbon black powder.

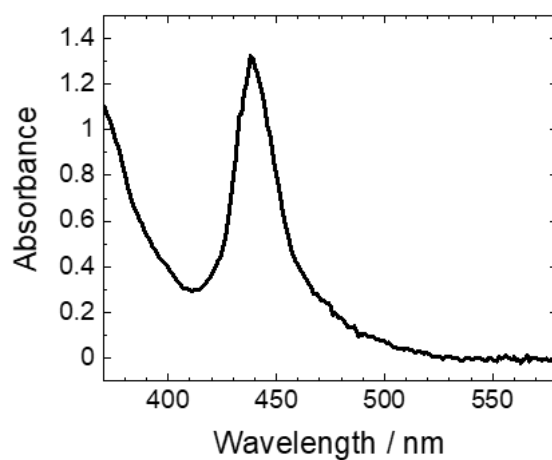


Figure S7. UV-visible absorption spectrum of the FTO/TiO₂/Cs₂AgBiBr₆ junction.

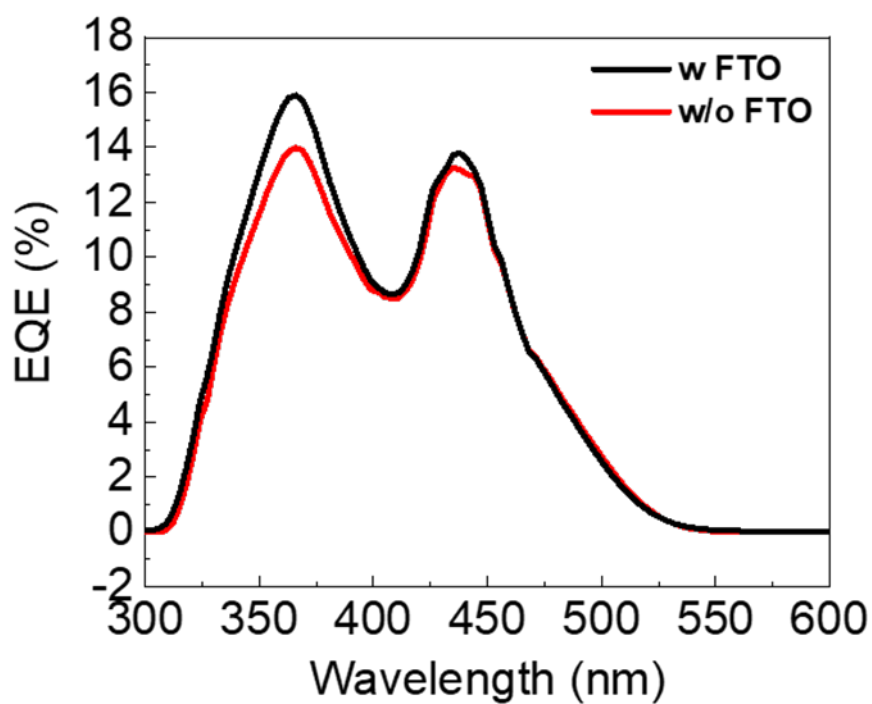


Figure S8. EQE spectra of a FTO/TiO₂/Cs₂AgBiBr₆/CE C-PSC with and without application of a clean FTO electrode on top of the CE.

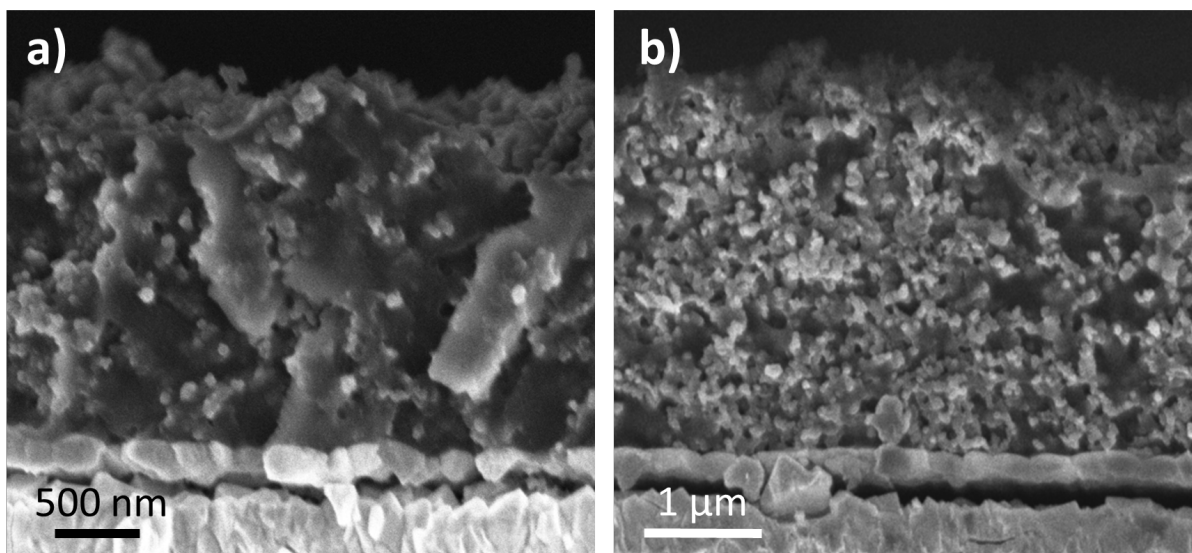


Figure S9. SEM cross-section images of C-PSCs based on screen-printed CEs prepared from a) iPA/PVP/carbon paste and b) CB/PMMA/carbon paste.

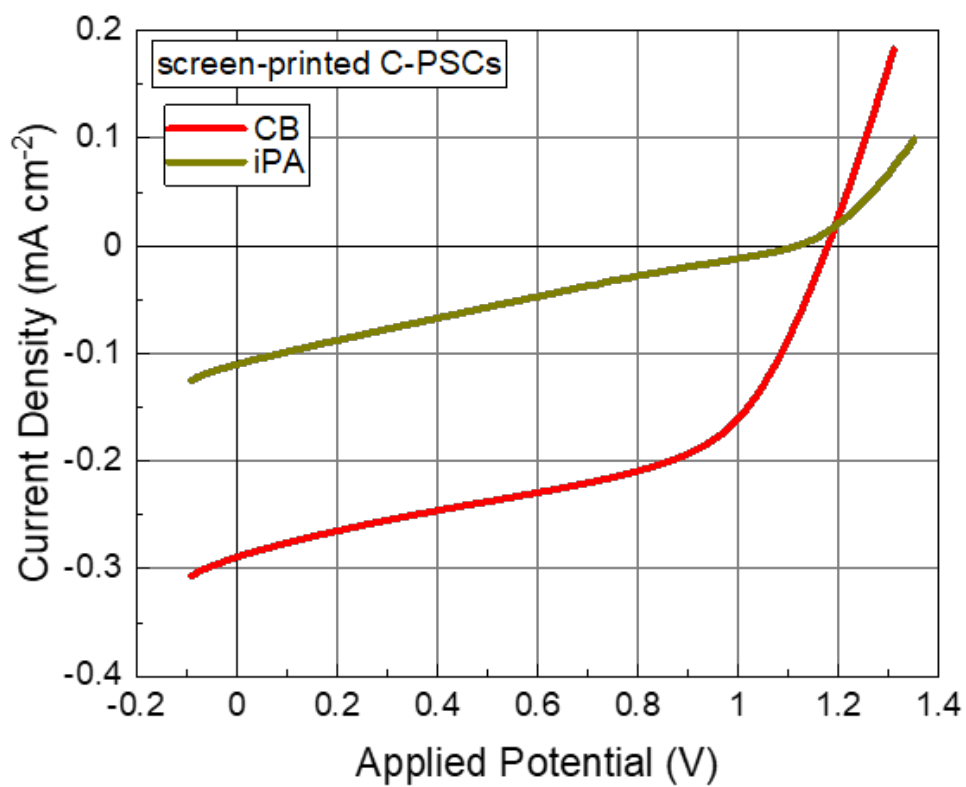


Figure S10. Prototypical J-V characteristics for C-PSCs based on screen-printed CEs prepared from iPA and CB pastes.