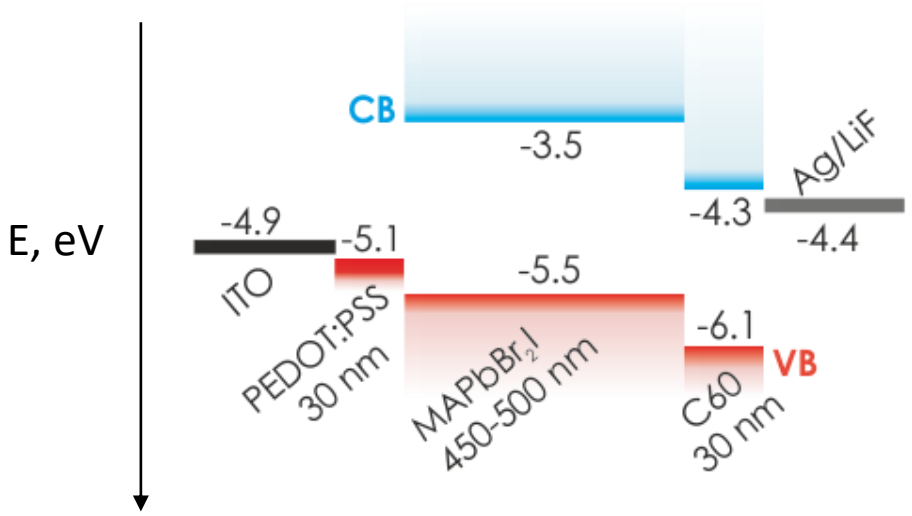
Light-emitting solar cell optical properties improving by solvent annealing

G.A. Verkhogliadov[1], D.S. Gets[1], M.A. Masharin[1], S.M. Makarov[1], A.A. Zakhidov[1,2]

1 Department of Physics, ITMO University, St. Petersburg 197101, Russian Federation

2 Alan G. MacDiarmid NanoTech Institute, University of Texas at Dallas, Richardson, TX 75083, USA



Abstract: Mixed halide perovskite allows the realization of a light-emitting solar cell (LESC) with the standard architecture of perovskite solar cells (SC). Such a design approach remains photovoltaic parameters high, but performance in the light-emitting diode (LED) regime still must be improved. Here we investigate some defect passivation methods for LED regime performance increasing in LESCs.

References

[1] Nature Photonics volume 12, pages 355–361 (2018)

[2] Nano Lett. 2018, 18, 3, 2172–2178

[3] Adv. Energy Mater. 2016, 6, 1600330

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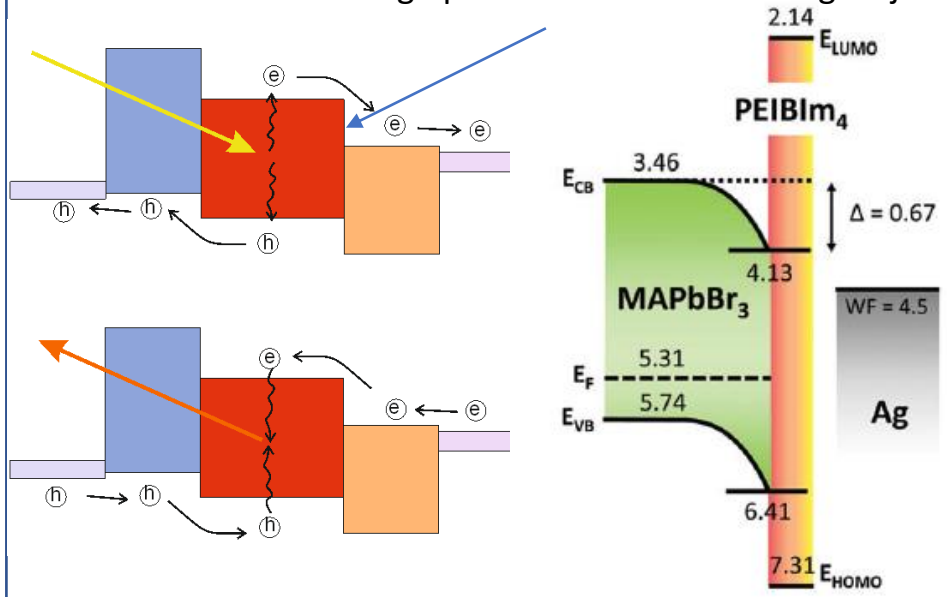
Dualfunctional devices

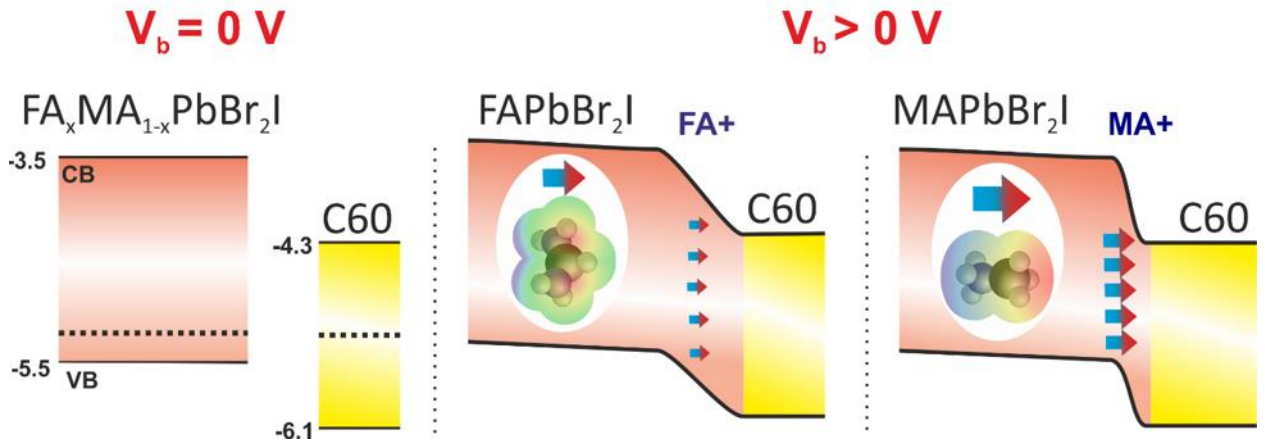
High potential barrier for charge injection



References

[4] ***Energy Environ. Sci.***, 2017,**10**, 1950-1957

Electrically driven dipole layer formation



Under applied voltage organic cations with nonzero dipole momentum migrates to interface with C60 and form a dipole layer, which reduce the potential barrier.

References

[5] arXiv:1910.12285

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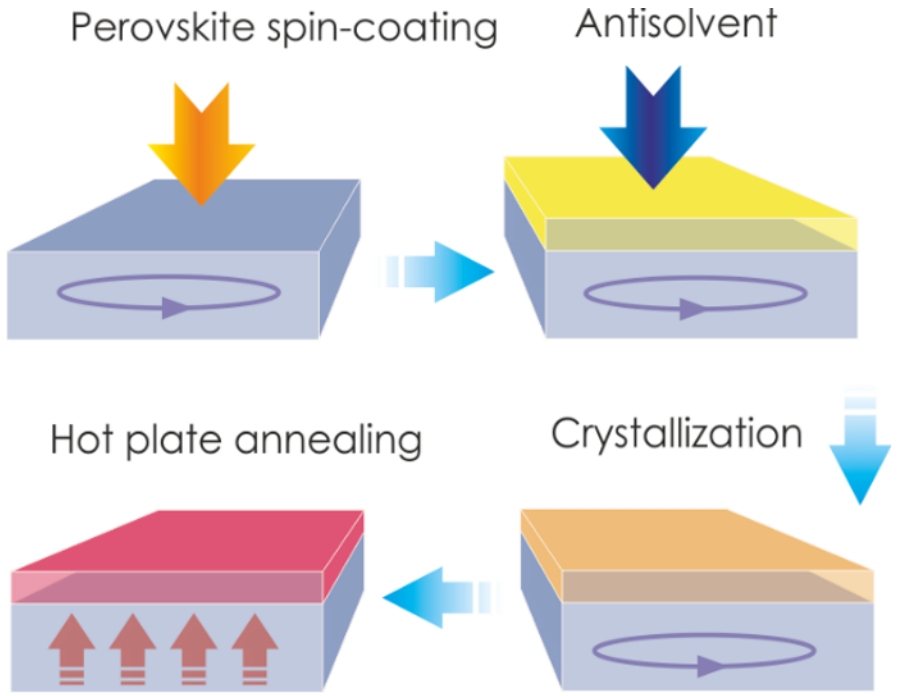
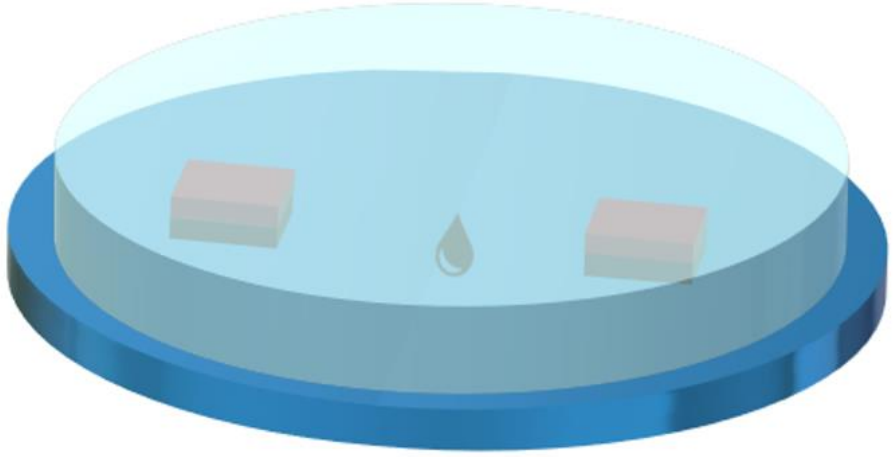
Spin coating



Solvent annealing



DMF and DMSO were used for a solvent annealing
T = 100C
t=20 min

References

[6] Nano Energy, Volume 28, October 2016, Pages 417-425

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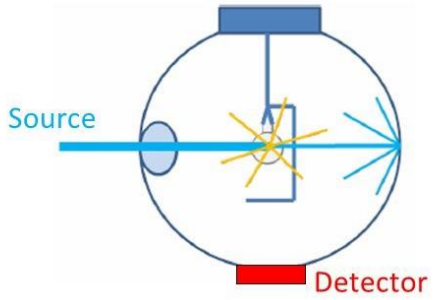
PLQY and PL lifetime measurements

PLQY measurements scheme

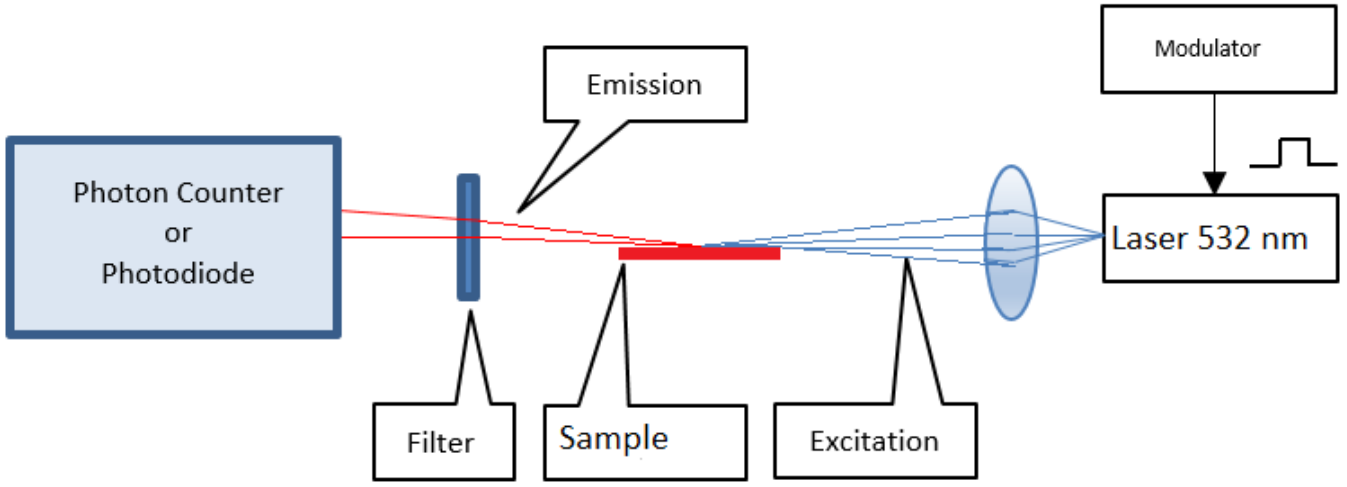
$$\Phi = \frac{\#\text{ of photons emitted}}{\#\text{ of photons absorbed}}$$



Integrating Sphere

PL Lifetime measurements scheme

$$I(t)=\sum Ai*\exp(-t/ti)$$



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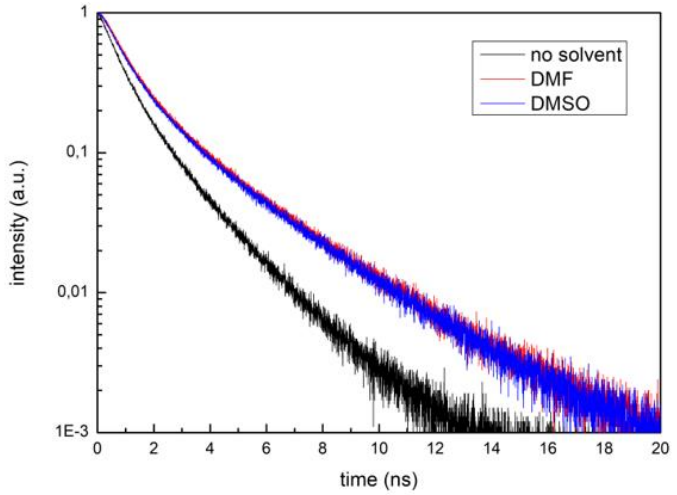
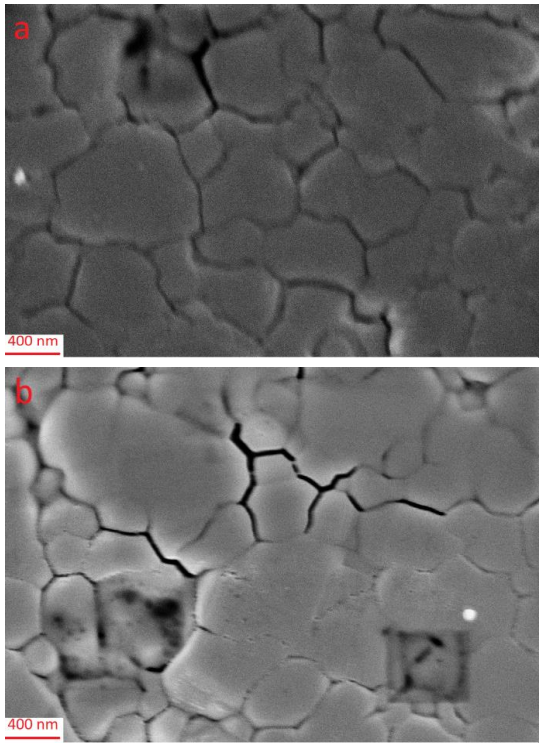
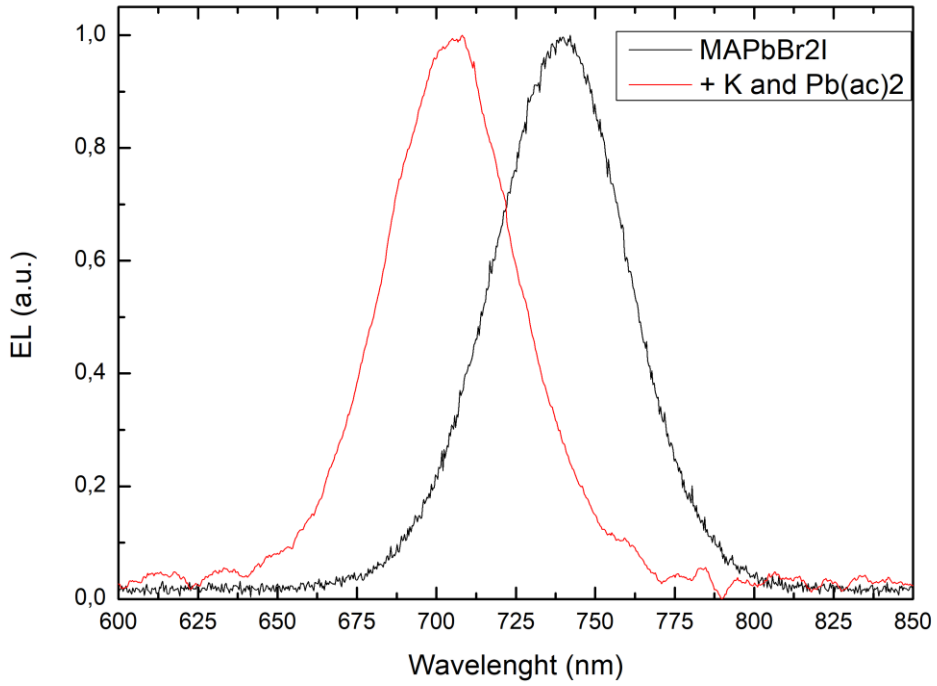




Intensity, mW/cm^2	PLQY, % (no solvernt)	PLQY, % (DMF)	PLQY, % (DMSO)
17.5	5.64	5.2	8.85
65.6	3.22	6.72	10.47
106	3.42	6.43	13.83

Segregation suppression



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1. Light-emitting solar cell optical parameters can be improved by grain surface modification and photoactive layer composition changing.
2. Solvent annealing leads to grain size increasing and reduce nonradiative recombination via defects.
3. Potassium halide and lead acetate addition provide blue shift of electroluminescence to visible range.

g.verkhogliadov@metalab.ifmo.ru