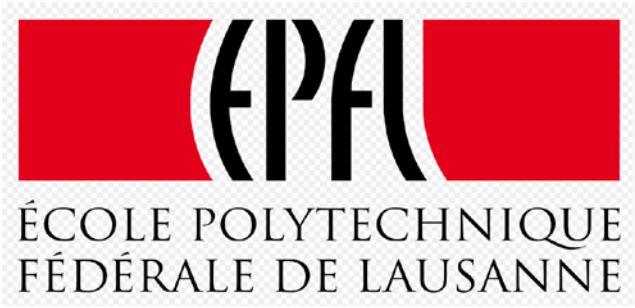
Null current hysteresis for acetylacetonate electron extraction layer in perovskite solar cells

Prof. Abd. Rashid bin Mohd Yusoff

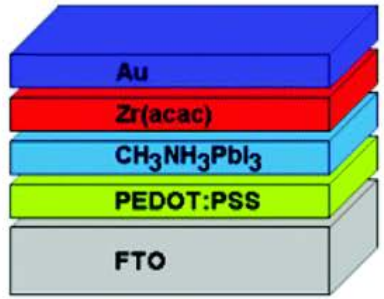
KHU – Seoul, South Korea

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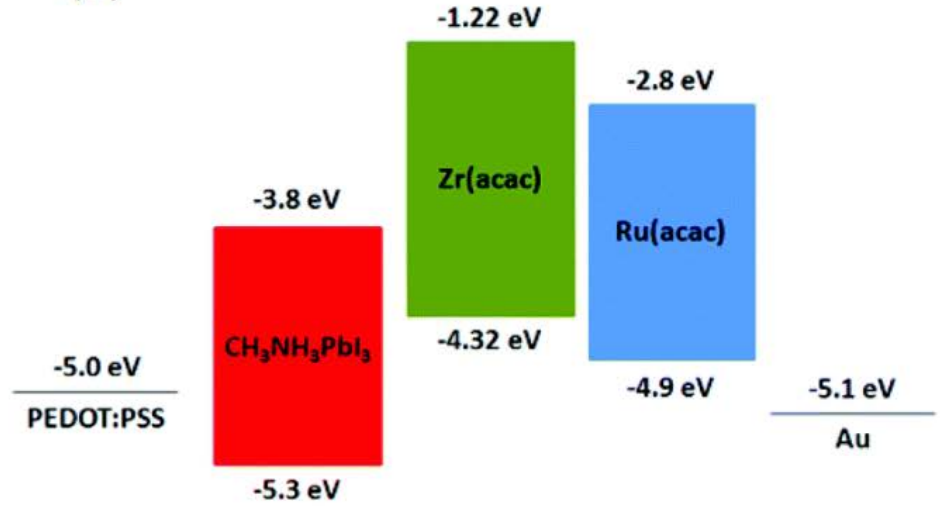




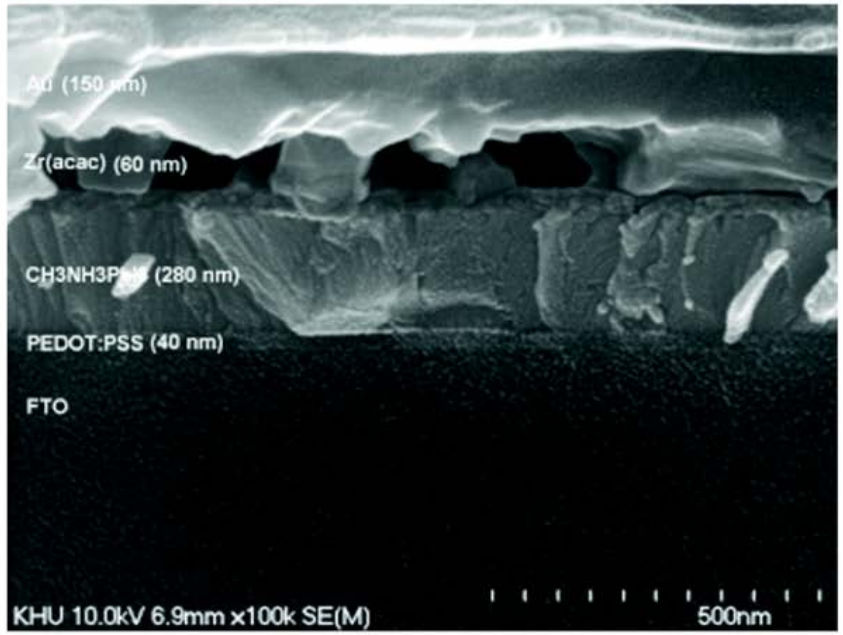
(a)


Au
Zr(acac)
CH3NH3PbI3
PEDOT:PSS
FTO

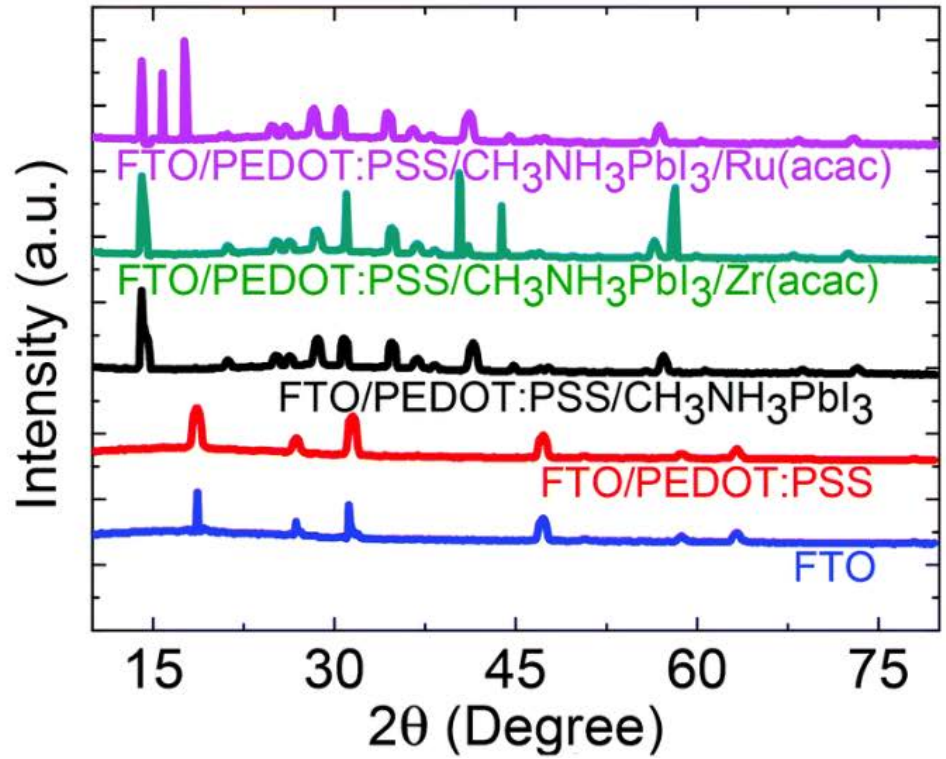
(b)

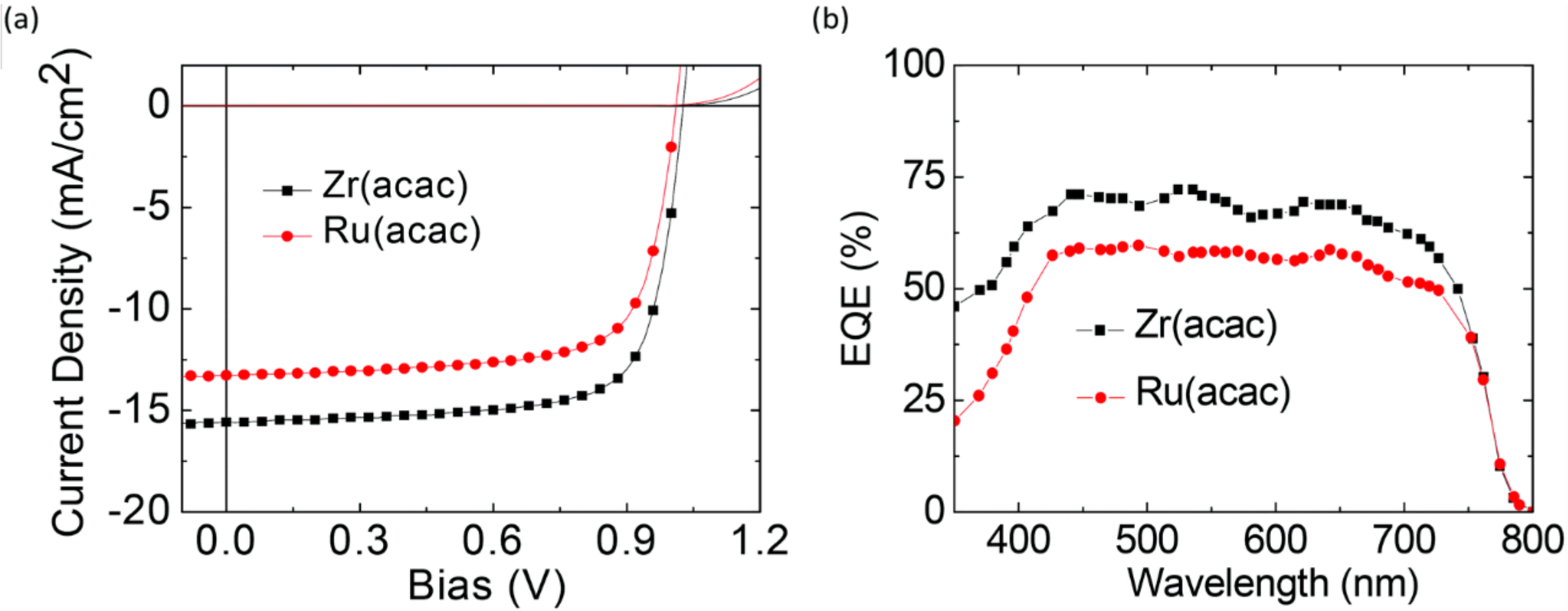

-4.5 eV
FTO
-5.0 eV
PEDOT:PSS
-3.8 eV
CH3NH3PbI3
-5.3 eV
-1.22 eV
Zr(acac)
-4.32 eV
-2.8 eV
Ru(acac)
-4.9 eV
-5.1 eV
Au

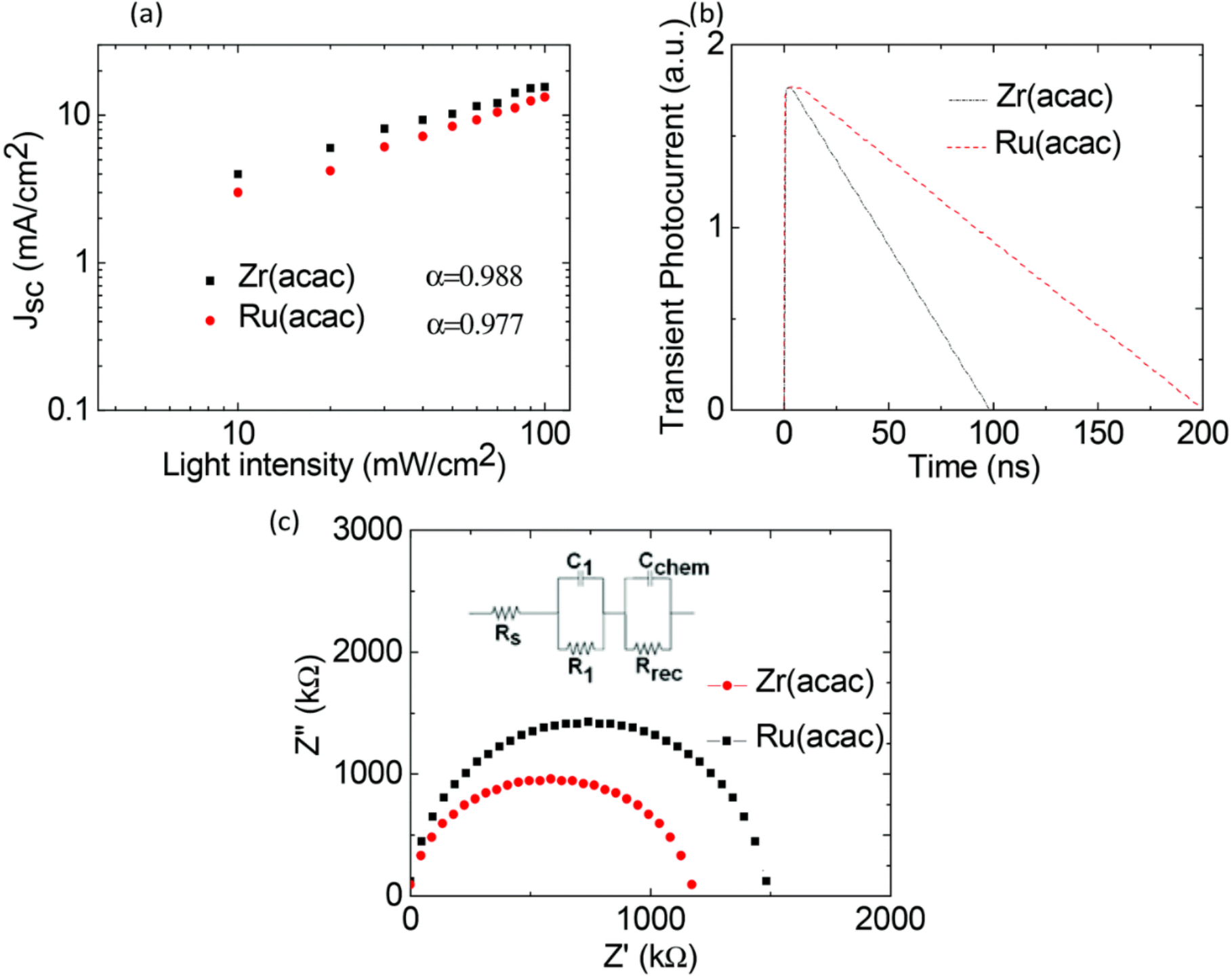
(c)

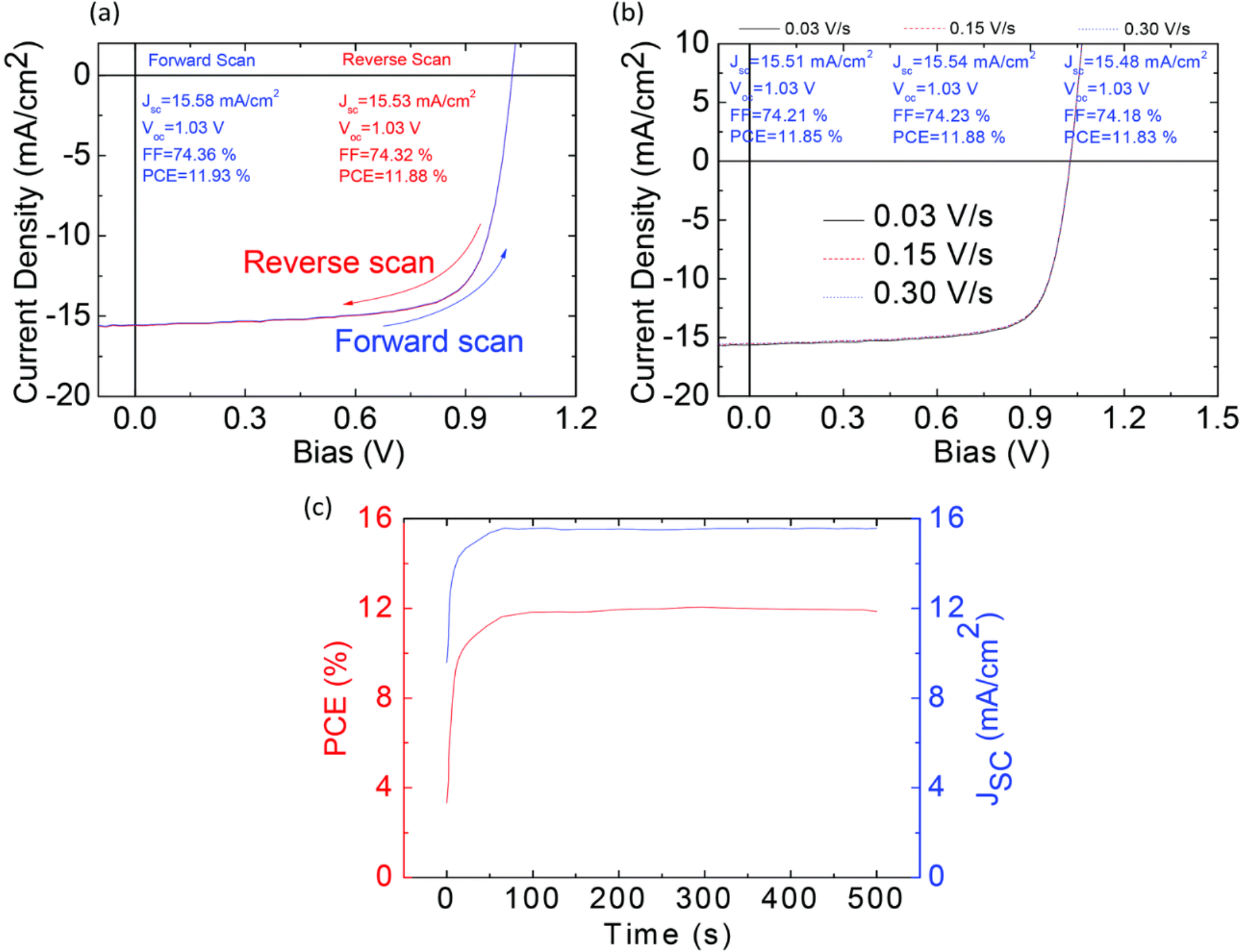

Au (150 nm)
Zr(acac) (60 nm)
CH3NH3PbI3 (280 nm)
PEDOT:PSS (40 nm)
FTO
KHU 10.0kV 6.9mm x100k SE(M)
500nm

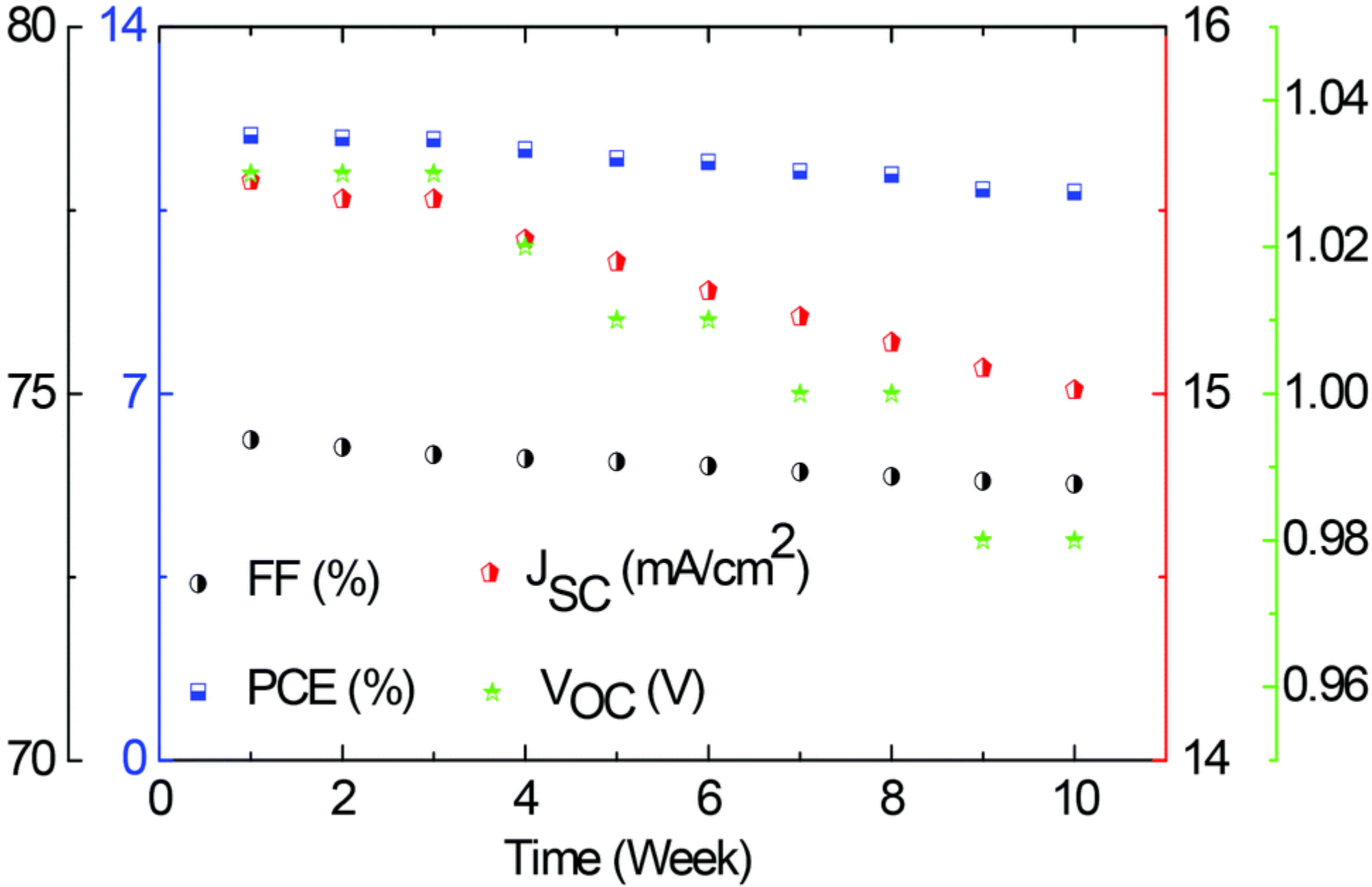
(d)


FTO/PEDOT:PSS/CH3NH3PbI3/Ru(acac)
FTO/PEDOT:PSS/CH3NH3PbI3/Zr(acac)
FTO/PEDOT:PSS/CH3NH3PbI3
FTO/PEDOT:PSS
FTO
Intensity (a.u.)
15
30
45
60
75
2θ (Degree)


(a)
Current Density (mA/cm2)
0
-5
-10
-15
-20
0.0
0.3
0.6
0.9
1.2
Bias (V)
Zr(acac)
Ru(acac)
(b)
EQE (%)
100
75
50
25
0
400
500
600
700
800
Wavelength (nm)
Zr(acac)
Ru(acac)


(a)
J_{sc} (mA/cm^2)
10
1
0.1
10
100
Light intensity (mW/cm^2)
Zr(acac)
Ru(acac)
α=0.988
α=0.977
(b)
Transient Photocurrent (a.u.)
2
1
0
0
50
100
150
200
Time (ns)
Zr(acac)
Ru(acac)
(c)
3000
2000
1000
0
Z'' (kΩ)
0
1000
2000
Z' (kΩ)
C_1
C_{chem}
R_s
R_1
R_{rec}
Zr(acac)
Ru(acac)


(a)
Forward Scan
Reverse Scan
J_sc=15.58 mA/cm^2
V_oc=1.03 V
FF=74.36 %
PCE=11.93 %
J_sc=15.53 mA/cm^2
V_oc=1.03 V
FF=74.32 %
PCE=11.88 %
Reverse scan
Forward scan
Current Density (mA/cm^2)
Bias (V)
(b)
0.03 V/s
0.15 V/s
0.30 V/s
J_sc=15.51 mA/cm^2
V_oc=1.03 V
FF=74.21 %
PCE=11.85 %
J_sc=15.54 mA/cm^2
V_oc=1.03 V
FF=74.23 %
PCE=11.88 %
J_sc=15.48 mA/cm^2
V_oc=1.03 V
FF=74.18 %
PCE=11.83 %
Current Density (mA/cm^2)
Bias (V)
(c)
PCE (%)
J_SC (mA/cm^2)
Time (s)


80
75
70
14
7
0
16
15
14
1.04
1.02
1.00
0.98
0.96
0
2
4
6
8
10
Time (Week)
FF (%)
J_{SC} (mA/cm^2)
PCE (%)
V_{OC} (V)