Electronic Supplementary Material (ESI) for Materials Advances.
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Supplementary Information

Capacitance and electric field-induced polarization behaviour of polymer functionalized palladium iodide nanoparticles

Figure: S1

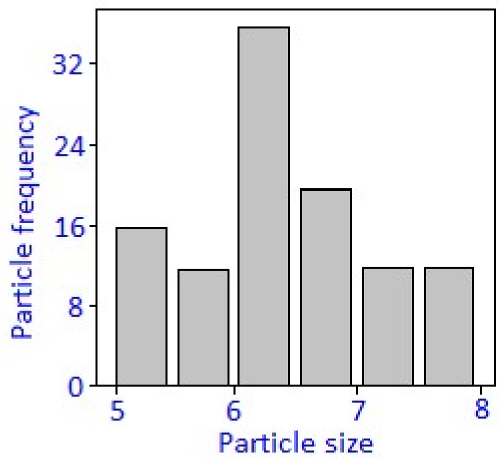

Figure S1: Particle size as a function of particle frequency histogram of the palladium iodide nanoparticles

Table S1: Fitting parameters (R_0, R_1, R_2, Q_1, Q_2, α_1 and α_2) extracted from the equivalent electrical circuits (figure 4, A and B, in-set) for the POT, PIOT-5 and PIOT based device under ambient temperature (30°C).

Device	$R_0(\Omega)$	Q_1 (nF)	α_1	R_1 (Ω)	Q_2 (nF)	R_2 (Ω)	α_2
POT	3.59	0.170	0.93	---	0.57	82.14	0.98
PIOT-5	16.56	0.77	0.67	---	0.91	122.1	0.94
PIOT	1.73	0.89	0.75	85.90	0.97	110.6	0.97

Complex dielectric constant (ε*) within the model of modified Cole-Cole relation, represented by using the following equation:

$$\varepsilon^* = \varepsilon_\infty + \frac{(\varepsilon_s - \varepsilon_\infty)}{1 + i(\omega\tau)^{1-\alpha}} \quad \text{(S1)}$$

Where, ε_s is the static part of the dielectric constant, ε_∞ is dielectric constant at infinite high frequency. The parameter α was related to the width of the relaxation time distribution and 'τ' is the relaxation time.

Separating the real (ε′) and imaginary (ε″) part of the dielectric constant from the above equation:

$$\varepsilon' = \varepsilon_\infty + \frac{(\varepsilon_s - \varepsilon_\infty)\{1 + (\omega\tau)^{1-\alpha}\sin\left(\frac{\alpha\pi}{2}\right)\}}{1 + 2(\omega\tau)^{1-\alpha}\sin\left(\frac{\alpha\pi}{2}\right) + (\omega\tau)^{2n}} \quad \text{(S2)}$$

$$\varepsilon'' = \varepsilon_\infty + \frac{(\varepsilon_s - \varepsilon_\infty)\{(\omega\,\tau)^{1-\alpha}\cos\left(\frac{\alpha\pi}{2}\right)\}}{1 + 2(\omega\tau)^{1-\alpha}\sin\left(\frac{\alpha\pi}{2}\right) + (\omega\tau)^{2n}} \quad \text{(S3)}$$

Where, $n = 1\text{-}\alpha$, and α represents the tilt angle ($\alpha\pi/2$) of the semicircular arc. Larger the value of α, means the broader distribution of relaxation times.[R1]

For an ideal Debye model, n = 1, ($\alpha = 0$) and for a non-Debye condition $0 \leq \alpha \leq 1$ [1]. The extracted 'α' parameter are 0.10, 0.11 and 0.13 for POT, PIOT-5 and PIOT, respectively.

Figure: S2

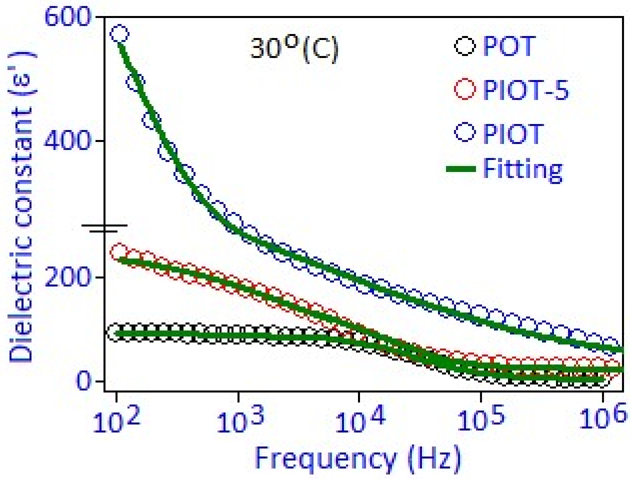

Figure S2: The dielectric constant (ε′) for POT, PIOT-5 and PIOT under ambient temperature (30 °C). The curves are fitted according to the modified Cole-Cole equation S2 (green colour line).

Table S2: Fitting parameters, α_1, α_2 and α_3, extracted from SCLC model, for the three different regions (I, II and III) for POT, PIOT-5 and PIOT based devices, respectively.

Device	α_1	α_2	α_3
	Region (I)	Region (II)	Region (III)
POT	1.5	2.2	1.2
PIOT-5	1.6	3.6	1.4
PIOT	2.2	4.8	1.8

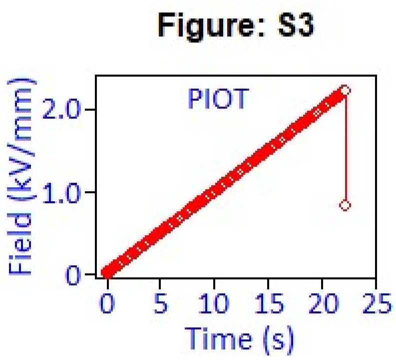

Figure S3: Electrical breakdown strength (kV/mm) with respect to time (s) for PIOT based device.

References:

R1. G. Govinda Raju, Dielectric loss and relaxation-I from: Dielectrics in electric fields, CRC press, London, UK, second edition, 2016.