

Wireless Electrochemiluminescence at Functionalised Gold Microparticles using 3D Titanium Electrode Arrays

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Background:

ECL is by nature a 2D process, thus it is strictly confined to electrode/solution interface. Wireless ECL on the other hand can circumvent this challenge.

Objectives:

- Use the electric field generated wirelessly within the solution to transport the gold microparticles capped 11-mercaptoundecanoic acid (AuMP-MUA) by electrophoresis or electro-osmotic flow.
- To elucidate the electric field distribution using 3D feeder electrodes.

Method:

- 3D microcylinder arrays have been created using selective laser melting with 300 μ m diameter microcylinders and inter-microcylinder separations of approximately 825 μ m.

Results:

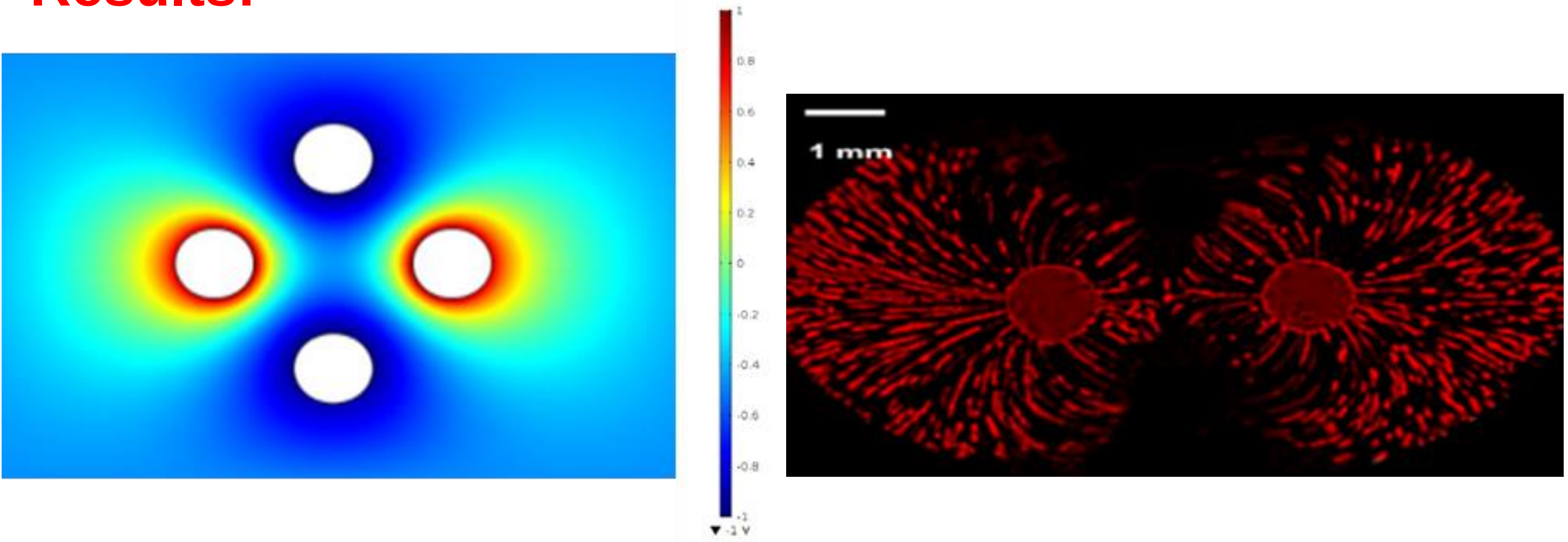
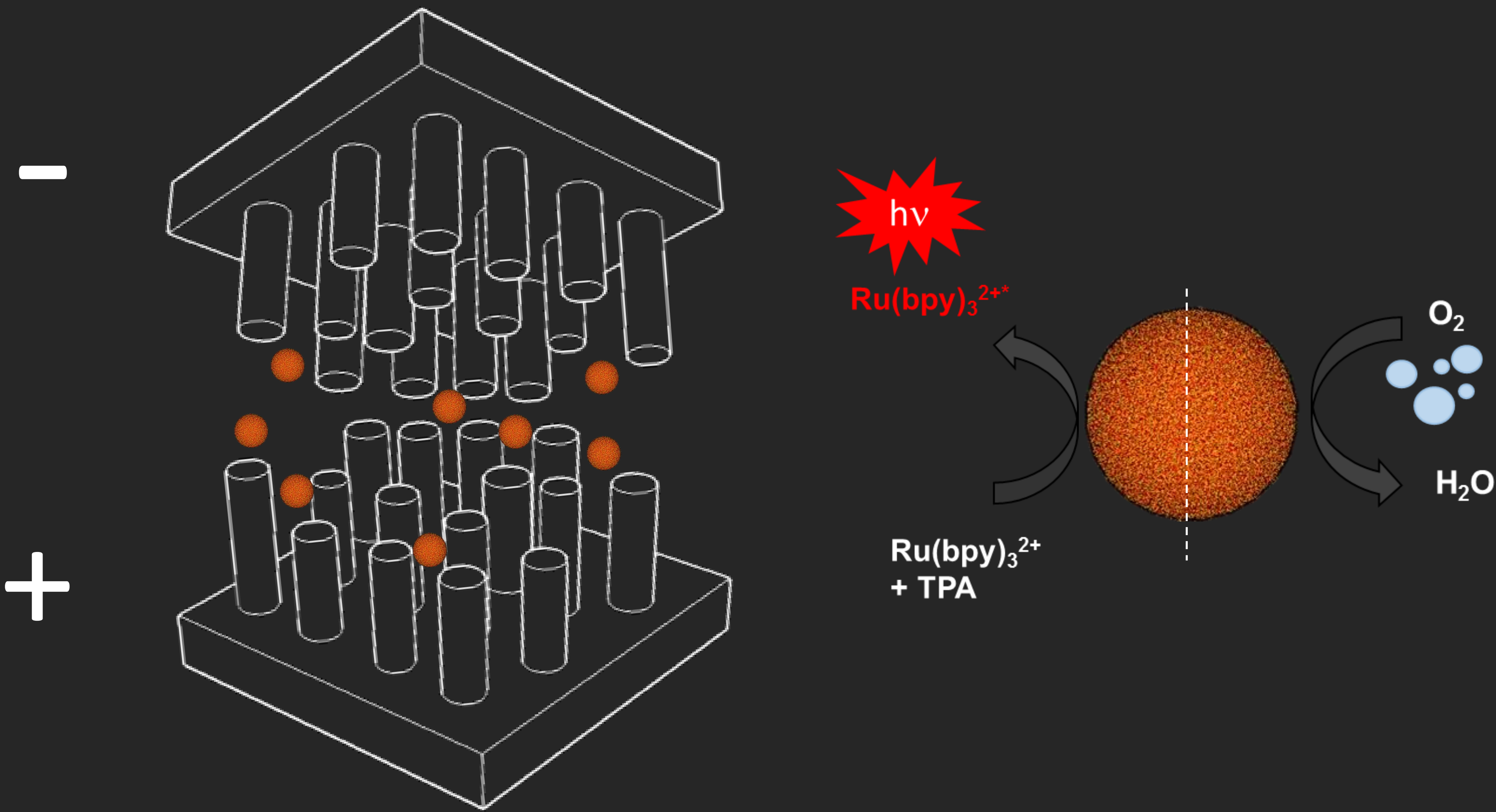
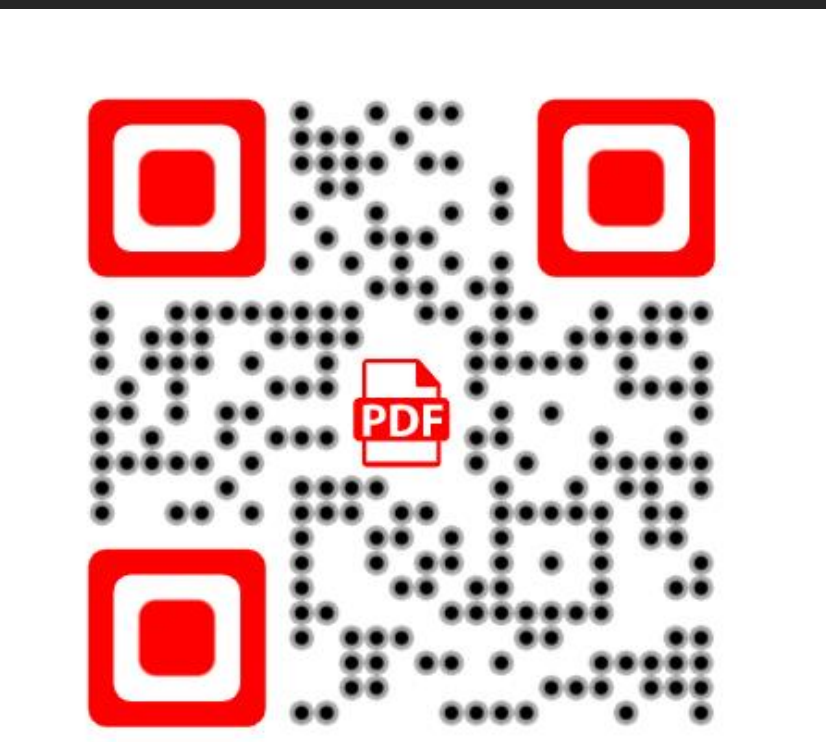
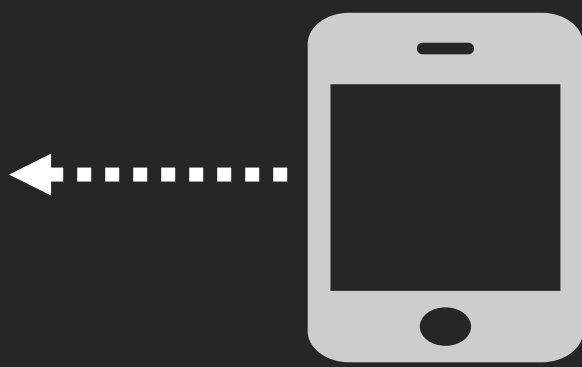


Figure 1: COMSOL model and (B) confocal image of emission at 610 nm from a suspension of AuMP-MUA in a solution containing 1 mM $[\text{Ru}(\text{bpy})_3]^{2+}$ and 25 mM TPA in Milli-Q water (pH 6.8) between 3D feeder electrodes.

3-Dimensional Electrochemiluminescence



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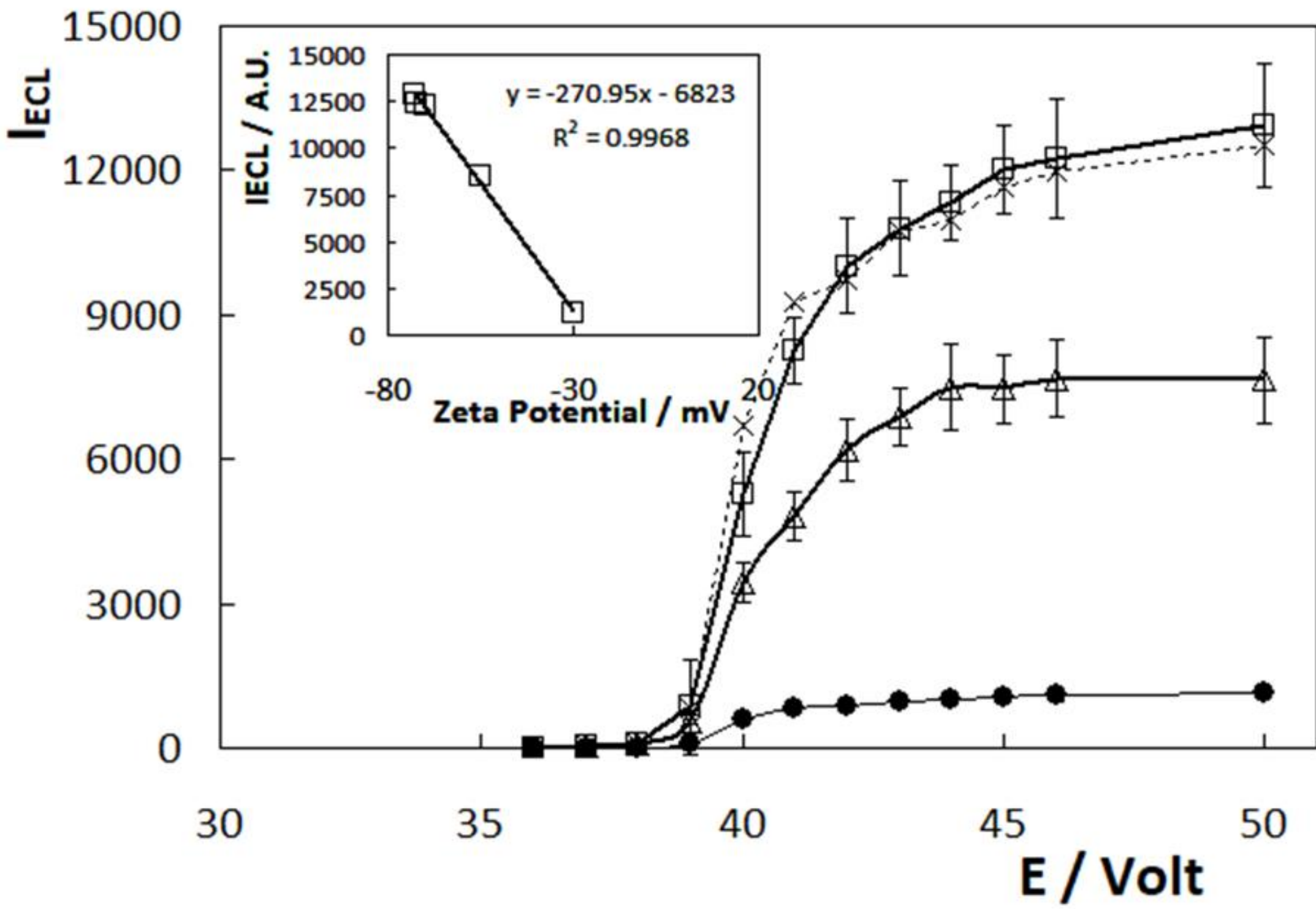


Figure 2: Dependence of the ECL intensity from a suspension of AuMP-MUA in a solution containing 1 mM $[\text{Ru}(\text{bpy})_3]^{2+}$ and 25 mM TPA on the electric field strength.

Discussion:

- By using 3D feeder electrodes intense electric fields was generated allowing the AuMP-MUA to be used as the bipolar electrodes.
- Modelling and long exposure fluorescence show that the electric field is non-uniform, opening up the possibility of spatially localising the ECL within bulk solution.

Conclusion:

- We show that by using AuMP-MUA as a massively parallel array of bipolar electrodes, ECL can be further enhanced by electrokinetic transport giving more particles per unit time entering the ECL generation zone.

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