6: Unveiling the potential of adhesion lithography towards development of plastic nanoelectronics

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ABSTRACT

Adhesion lithography (a-Lith) is a patterning technique that is based on the modification of adhesion forces between two sequentially deposited metals by functionalising the surface of one of them with a suitable self-assembled monolayer (SAM)[1]. The final a-Lith patterned structure comprises two metals separated laterally by a nanogap of <15 nm (Figure 1). The competitive advantage of this technique is that it is simple and scalable with high throughput, while it can be applied in any type and size of substrates.

Recently, we demonstrated the scalability potential of a-Lith by developing a semi-automated system to perform the peeling of the second metal layer that critically defines the nanogap size and its quality and thus we maximised the process yield. Significant progress has been also achieved in applying a-Lith to plastic (flexible) substrates and different types of metals to create symmetric or asymmetric electrode structures.

The versatility offered by this simple patterning technique to manufacture any type of coplanar metal structures on the same substrate enables the simultaneous fabrication and statistical study of a great number of electronic devices by simply spin-coating the material of choice on top of the metal structures from its solution and applying low temperature thermal annealing to retain compatibility of the whole process with plastic substrates.

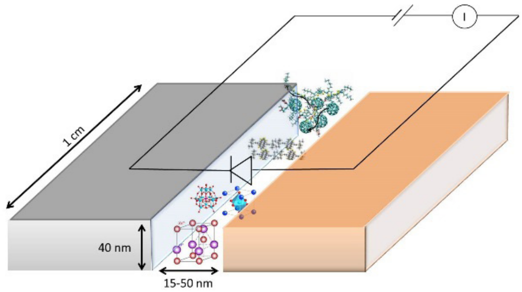

Figure 1. Schematic diagram of coplanar Au-Al asymmetric electrodes having a width of 1 cm, thickness of 40 nm and separated by a nanochannel (interelectrode distance) of 15-50 nm. Deposition of a suitable material in the nanogap and application of a bias between the electrodes allows current to flow from one metal to the other through the organic or inorganic material, that being the common underlying working principle of many electronic devices.

Herein, we will describe how deposition of a suitable functional material in the nanogap can give rise to a plethora of high performing nanoelectronic devices, such as radiofrequency Schottky diodes, nanoscale light-emitting diodes, photodetectors and ferroelectric tunnel junction memory devices. Emphasis will be placed on the different requirements posed by each application in terms of materials processing and electrodes geometry. Finally, we will showcase successful examples of proof-of-concept functional devices.

1. Beesley DJ, Semple J, Jagadamma LK, Amassian A, McLachlan MA, Anthopoulos TD*, et al.* Sub-15-nm patterning of asymmetric metal electrodes and devices by adhesion lithography. *Nature Communications* 2014, **5**.

BIOGRAPHY

Dr Dimitra G. Georgiadou is a Marie Skłodowska-Curie Research Fellow in the Experimental Solid State Physics group (EXSS) at the Blackett Laboratory, Imperial College London. Dimitra received her PhD in Photochemistry/Organic Electronics from the National Technical University of Athens. Before that she obtained a Master's Degree in Advanced Materials Science from the Technical University of Munich, Ludvig-Maximilians University of Munich and University of Augsburg. She has also gained industrial experience through internships in Procter&Gamble, Italy, and Schreiner Group, Germany. Dimitra is co-author of 40 publications in peer-reviewed journals (h-index: 14). Her research interests are the fabrication and optimisation of organic and hybrid electronic devices by applying novel materials concepts and alternative patterning techniques.