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BIOSENSORS FOR PANDEMICS

Real-time detection of viral surface antigens using hybrid graphene-gold Nanosensors [5]

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Introduction and Aims

Point-of-care (POC) diagnostics for disease detection are fast, cheap & easy to use in comparison to laboratory tests, requiring highly trained staff, large/expensive equipment & long time-to-result[1]. There has been rapid growth of POC diagnostics in recent years with increasing emphasis on resource-limited settings[2] & and with applicability to infectious diseases. A nanosensor based on a graphene resistor functionalized with AuNPs (Gold Nanoparticles) is demonstrated for the real-time detection of hepatitis B surface antigen (HBsAg). Graphene–AuNP hybrid structures are of particular interest in sensing applications because they display individual properties of graphene and AuNPs, but can also exhibit additional synergistic properties[4]. The aims of this work were 1) to create a graphene sensor for the detection of a viral surface antigen, 2) measurements to be taken in real-time & 3) to measure more than one channel independently and simultaneously.

Graphene-AuNP hybrid manufacture

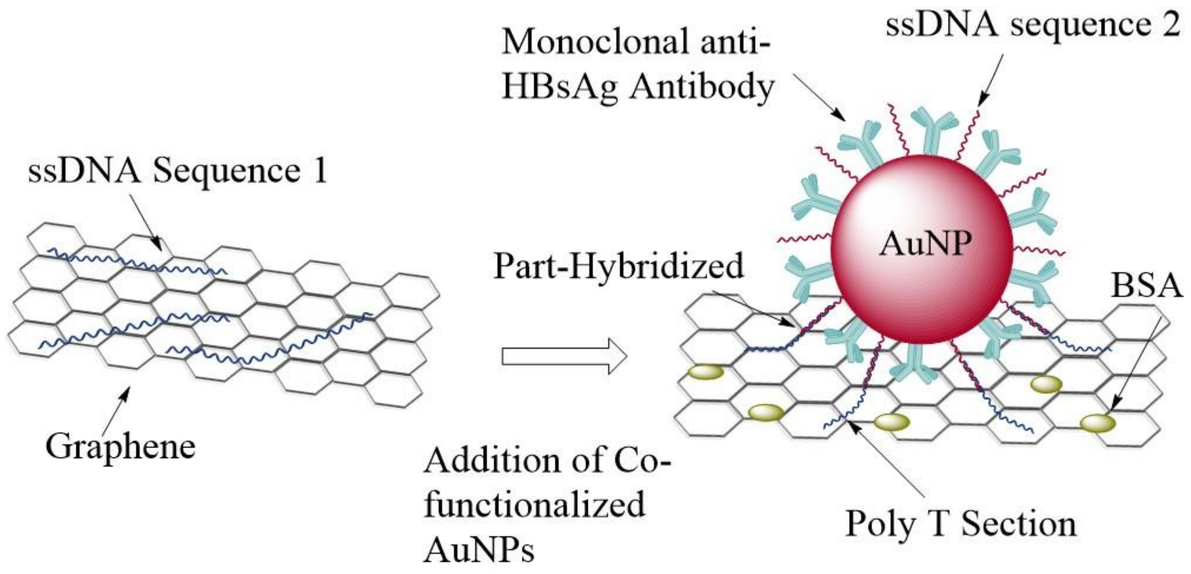

Figure 1: Graphene-AuNP hybrid: AuNPs co-functionalized with monoclonal anti-HBsAg antibody and ssDNA sequence 2 incubated with the ssDNA functionalized (sequence 1) graphene. The part-sequence is hybridized to dsDNA while poly T section remains π-π stacked to the graphene, anchoring the particle to the surface.

Device design

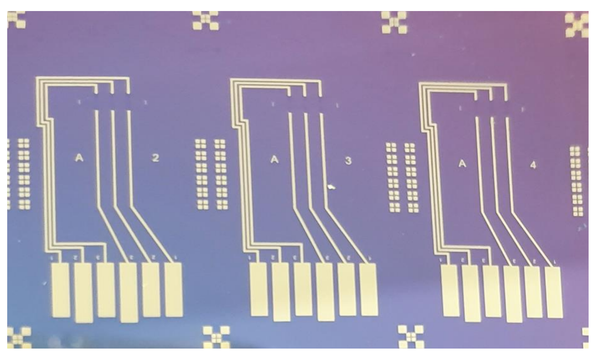

Figure 2: Optical image graphene biosensor chips without a passivation layer applied

Results – Real-time sensing of HBsAg

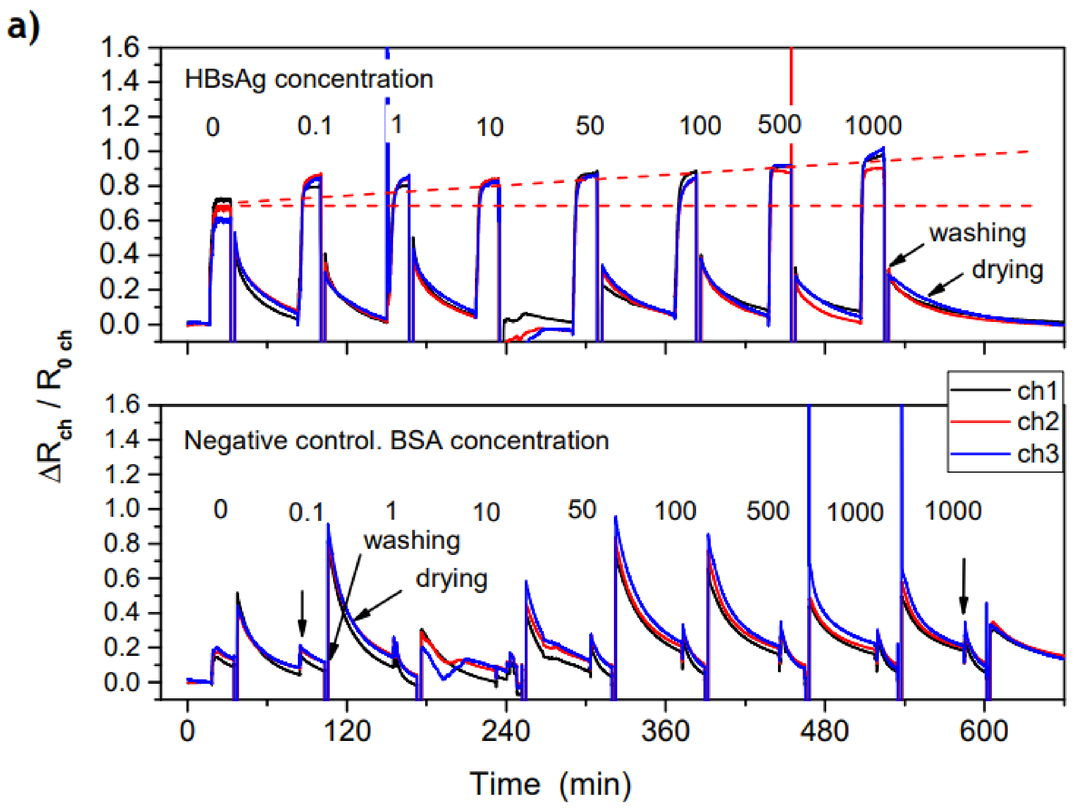

Figure 3: a) Graphene channel resistance response with respect to the time-dependent application of various HBsAg concentrations in pg/ml (top) and at various BSA concentrations in pg/ml (bottom). Three channels measured simultaneously. Where ΔR= $R_{channel}$ – $R0_{channel}$, and R0 channel is the initial resistance measurement. **b)** Normalized graphene channel resistance against log HBsAg concentration. An experimental limit of detection (LOD) was measured as an increase of the resistance above this horizontal region at >50 pg/ml [5].

Conclusions

A three channel graphene sensor device were fabricated and functionalized for the detection of HBsAg. Three channels measured independently and simultaneously in real-time with similar behaviours observed for all. $\Delta R_{ch} / R0_{ch}$ increased with increasing HBsAg concentration with no signal increases observed with a negative protein control. The hybrid biosensor platform has potential to be applied to other viral proteins or any biomarker of interest.

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