Enhanced control of antibody anchoring in graphene-based biosensors

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Abstract: Point-of-care diagnostics are based on portable biosensors, therefore their improvement is crucial for reducing the burden on national healthcare systems. Immunosensors are one of the key classes of biosensors due to the highly specific antigen-antibody interactions. Different materials can serve as signal transducers, in particular graphene and its derivatives, owing to their high surface area, excellent electron transport, and unique electronic properties, which are key to enhancing sensor sensitivity.[1] In addition to its properties, graphene derivatives can be formulated into conductive inks, enabling the transition from rigid devices to flexible electronics through inkjet printing.[2]
To improve biosensor sensitivity, antibody bioconjugation to the sensor surface is one of the most critical steps. The current gold standard is based on amidation reactions, which exploit free amine groups on antibody side chains and carboxylic acid groups on the surface, whether intrinsically present or introduced by chemical modification.[3] Despite its efficiency, it leads to antibody clustering and random orientation, thus decreasing the antigen recognition and therefore reducing the biosensor performance.
In this work, we focused on the development of a chemically modified graphene-based ink incorporating hydrazide functional groups. This enables controlled antibody immobilization through selective reactions with aldehydes obtained by oxidizing the glycan moieties on the heavy chain of the antibody. This strategy allows an improved antibody orientation and decreased clustering, therefore minimizing antibody inactivation.[4] Finally, the ink viscosity and surface tension were optimized to meet the stringent requirements of inkjet printing, and the resulting physicochemical properties were comprehensively evaluated.

References

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Figures

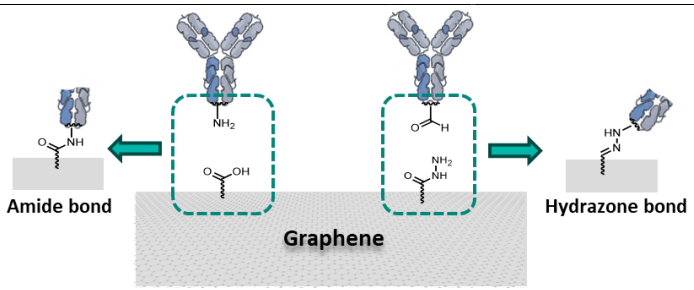

Figure 1: Different bioconjugation approaches for antibodies.