

# Graphene-based piezoelectric immunosensor instrument for antibody detection

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Developing accessible, adaptable and field-serviceable disease screening tools is of great importance for early disease detection and thus for preventing delays on medical interventions. Graphene materials have demonstrated great potential for the functionalization of biosensing surfaces enhancing their detection capabilities, as we have previously reported [1,2]. We present a sensitive and low-cost immunoassay based on a customised open-source quartz crystal microbalance instrument coupled with graphene biointerface sensors (G-QCM) to quantify antibodies in undiluted patient serum (Figure 1). We show its efficacy for a particular antibody against the phospholipase A2 receptor (anti-PLA2R) for differential diagnosis of membranous nephropathy [3]. Our device employs a novel graphene-protein bio-interface constructed by adsorbing a low concentration of denatured bovine serum albumin (dBSA) on the reduced graphene oxide (rGO) sensor surface [2]. The dBSA film prevents the denaturation of the protein receptor on the rGO surface and serves as the cross-linker to immobilize the smallest domain of extracellular PLA2R (NC3) as a receptor for anti-PLA2R antibody on surface activated by EDC and sulfo-NHS. The detection limit and selectivity of this G-QCM sensor and instrument was compared with a commercial QCM system. The G-QCM immunoassay exhibited good specificity and high sensitivity toward the target, with an order of magnitude better detection limit (of 100 ng/mL) compared to the commercial system, at a fraction of the cost. The results obtained from patient sera compared favourably with those from enzyme-linked immunosorbent assay (ELISA), validating the feasibility of clinical applications. The multifunctional dBSA-rGO platform emerges as a promising bio-functionalization method for universal immunoassay and biosensors. Due to its low cost, rapid and sensitive detection, our G-QCM sensor and instrument form an effective autoimmune disease screening tool suitable for prompt diagnosis and rapid therapeutics development [4].

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## References

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## Figures

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