

Carboxyl-Graphene quantum dots-dextran based surface plasmon resonance immunosensor for the detection of cancer

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Abstract

The development of graphene quantum dots(GQD) has led to a new trend in the biosensing field, owing to its high sensitivity and bio-affinity characteristics with regards to the simple synthesis of GQD. In this study, we used glucose to successfully synthesis GQD. And we modify two-dimensional GQD to GQD-Dextran, that is three-dimensional structure. Next we modify GQD-Dextran to GQD-Dextran-COOH with Bromoacetic acid. The efficiency of Bromoacetic acid modification method showed a higher -COOH group content, mainly due to bromine atoms occupying the Dextran to allow for the formation of a strong bonding effect. This then enhanced the surface area of -COOH and improved the formation of covalent bonds between proteins. We demonstrated that GQD-Dextran-COOH-based surface plasmon resonance (SPR) chips can provide excellent sensitivity and high affinity for immunoassay biomolecules detected. The results thus obtained revealed that the GQD-Dextran-COOH chip can be significantly enhanced that of the GQD chip. In summary, the excellent binding affinity, biocompatible and high sensitivity suggest the potential of the clinical application of this GQD-Dextran-COOH-based SPR chip detection method for in vitro diagnostic and point-of-care testing devices.

Graphene quantum dots(GQD) is a two-dimensional single-layer or multi-layer material with semiconductor energy gap, excellent optical and mechanical properties, and chemical, thermal high stability, and novel materials with great potential. It is a popular material for research in recent years.

The bonding of different functional groups between molecules can be applied in various fields. Modifying the surface functional groups of molecules is a hot research topic in recent years. In this experiment, in order to enhance the sensitivity of GQD, we modify GQD with Dextran, which is three-dimensional material. The surface functional group of GQD was modified, and the carboxyl group (Carboxyl, -COOH) was modified on the surface of GQD-Dextran to synthesize the GQD-Dextran-COOH to improve the sensitivity of biosensing.

Surface plasmon resonance (SPR) biosensing technology uses laser light to enter the metal and dielectric interface. The interface generates energy coupling at a specific angle of incidence to form a surface plasmon polarizer (SPP). Surface biobonding is detected by the surface having different refraction angles (SPR angles) due to refractive index changes. This is an important technology used in biomedical testing in recent years.

Keywords –Graphene quantum dots(GQD), Dextran, Surface plasmon resonance(SPR)