Graphene-based surface plasmon resonance biosensors for multi-parametric analysis of living cells

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White blood cells (leukocytes) are a key component of the immune system. Changes in their composition and biological activity are important markers of health status. Studies of multiple activity parameters, e.g. densities of various receptors, would allow earlier and more accurate disease diagnosis. Due its high sensitivity, graphene is used as a component in different types of optical and electrical biosensors [1,2]. Among existing biosensing techniques for cell analysis, surface plasmon resonance (SPR) is very promising because it combines high sensitivity with label-free and real-time read-out. The integration of graphene in SPR-based sensors may further increase sensor performance. To test this hypothesis, we transferred large-area CVD-grown graphene onto SPR biosensor chips. Novel synthetic peptides were chemically attached to graphene via pyrene-based linkers. These high affinity peptides can specifically interact with receptors on the cell surface (Figure 1, left). Living model cells with controlled expression of specific receptors were used to study the peptide-cell interaction on graphene-coated SPR chips. We observed a strong signal upon binding of cells with receptors on peptides (Figure 1, right). Control measurements with cells without receptors showed much lower signal due to non-specific binding. Preliminary data also suggests that graphene reduces non-specific binding compared to standard gold-coated SPR chips. Unlike conventional cell analysis methods, our technology is label-free and allows analysis of biological cell activity with high temporal resolution.

References

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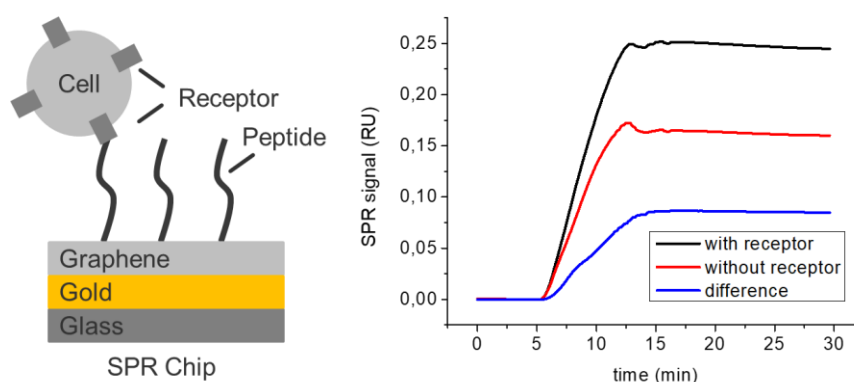
Figures

Figure 1: Binding of cells on biosensors with graphene and peptide coating. Left: Schematic sensor setup. Right: SPR signal as a function of time. Here, the binding of cells with and without receptors was compared. The difference between the two measurement curves gives the proportion of specific binding to peptides. The cell concentration was 275,000/ml in both cases.