

## Detection of Hydrogen Peroxide Using Ultra-Sensitive Microcantilevers

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Hydrogen peroxide is a product of numerous biological oxidation reactions, and is widely used in food, and pharmaceutical manufacturing. Hydrogen peroxide is a common bleaching agent used in many industrial settings such as the paper and textile industry, and is also used as a fertilizer in some agricultural areas. While the benefits of this chemical are apparent, if handled improperly, hydrogen peroxide can be very harmful to wildlife, the environment, and general population. The ability to detect this chemical would be beneficial.

In recent years, microcantilevers have emerged as an ideal platform for chemical and biological sensors with extreme sensitivity. Microcantilevers can be modified to detect very specific substances in both liquid and air mediums. The approach used to detect hydrogen peroxide in solution was made by immobilizing an enzyme, horseradish peroxidase (HRP), on the surface of microcantilever via layer-by-layer (LBL) technique. The LBL technique allows the formation of ultra thin, organized films on the surface of the microcantilever through alternate adsorption of oppositely charged components, such as polyions and enzymes. In this case, the films binding the HRP to the surface of the microcantilever consist of polyethyleneimine (PEI) and poly(sulfonate styrene) (PSS). The HRP is the key to the detection of hydrogen peroxide, because HRP only binds with hydrogen peroxide. When hydrogen peroxide is injected into a solution containing a HRP-modified cantilever, the hydrogen peroxide binds with the HRP and causes the enzyme to undergo a conformational change. When the conformational change occurs, the surface stress across the modified side of the microcantilever will change. This only occurs on the side of microcantilever that has been modified. When hydrogen peroxide floods is no longer present and the reaction stops, the cantilever starts to bend back. The enzyme-functionalized microcantilever deflects in response to hydrogen peroxide at the concentration down to nanomolar level. The magnitudes of bending were proportional to the concentrations of hydrogen peroxide.

In conclusion, a microcantilever modified by the LBL technique with the enzyme HRP imbedded in the nanolayer has been shown to be a detection method for hydrogen peroxide. By changing the microcantilever materials and structural design, the sensitivity of the sensor can be improved. The results of our project have shown that the surface modification of a microcantilever can be used to detect many other chemical and biological species when different enzymes or receptors are embedded in the multilayer.