DEVELOPMENT OF THE FIRST PIEZOELECTRIC IMMUNOSENSOR FOR RAPID AND ACCURATE DETERMINATION OF ANTIBODIES INVOLVED IN THE CELIAC DISEASE

A. Manfredi[1], M. Careri[1,2], S. Corradi[1], M. Giannetto[1,2],M. Mattarozzi[1,2]
[1]Dipartimento di Chimica, Università di Parma, Parco Area delle Scienze 17/A, 43124, Parma
[2]Centro Interdipartimentale SITEIA.PR, Università degli Studi di Parma, Parco Area delle Scienze 17/A, 43124, Parma

The Quartz Crystal Microbalance (QCM) attained significance as chemical and biological sensor based on piezoelectric transduction, allowing to study gas- and liquid-phase interactions between specific compounds and the functionalized crystal surface [1].
In this study the first piezoelectric immunosensor was developed for direct and rapid detection of the IgG and IgA anti-transglutaminase (anti-tTG) involved in the celiac disease, as a valid alternative to currently exploited serological blood tests.
Taking into account the difficulties related to signal instability due to viscosity and ionic force in liquid phase, several experiments were initially performed in order to find the best conditions assuring analytical stability, sensitivity and reproducibility using a QCM liquid/flow cell. The immunosensing strategy consisted of the immobilization on the gold surface, previously functionalized with a Self-Assembled Monolayer (SAM), of the open-tTG which presents an higher diagnostic accuracy than in the close conformation [2], followed by the detection of the immunoglobulin in the human serum through specific antigen-antibody interactions. In order to reach the requested sensitivity, the signal was properly amplified by using gold nanobeads (diameter, 10 nm) coated with goat anti-mouse antibodies, allowing anti-tTG detection at very low levels (LOD, 1 μg/mL). Moreover, sensor reliability was investigated by analyzing the same blood samples with a commercial ELISA kit, proving that the devised sensor is able to discriminate between control and patient, so it can be exploited as rapid, sensitive and accurate diagnostic device.

[1] A. Janshoff, H.J. Galla, C. Steinem, Angew. Chem. Int. Ed. Engl. (2000) 4004-4032.
[2] K. Lindfors, O. Koskinen, K. Kurppa, K. Laurila, P. Collin, K. Haimila, J. Partanen, P. Saavalainen, M. Mäki, K. Kaukinen, J. Clin. Immunol. (2011) 436-442.