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Hybrid material for detecting heterocyclic aromatic amines: a surface plasmon resonance approach

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Hybrid materials comprising of organic and inorganic molecules have been explored as analytical sensors due to a wider range of application possibilities. Because of the carcinogenic activity of heterocyclic aromatic amines (HAAs), which are produced during thermal processing of animal meat (cartoon representation in Fig. 1), detecting HAAs at low levels has become a major concern in food safety. This work deals with the production of a hybrid material (CS-FeCN) consisting of a chitosan film (286 ± 13 nm) and a coordination compound, $[Fe(CN)_5(OH_2)]^{3-}$, to detect quinoxaline (IQx) — a molecule used to mimic HAA due to the skeleton similarity (structure in Fig. 1). Multiparametric surface plasmon resonance (MP-SPR) was used to both monitor the adsorption of $[Fe(CN)_5(OH_2)]^{3-}$ into the chitosan film and detect IQx. For the complex adsorption, a SPR angle change ($\Delta\theta_{SPR}$) of 3442 mdeg was observed corresponding to a surface coverage of 28.68 ng cm^{-2}. The infrared vibrational spectrum of CS-FeCN showed a band at 2034 cm^{-1} assigned to the stretching mode of the CN moiety of the iron complex thus confirming its adsorption into the chitosan film. The use of CS-FeCN for detecting HAAs is based on the replacing reaction of H_2O by IQx within the coordination sphere of the iron complex (Fig. 1, center). In this study, the CS-FeCN material was adsorbed onto gold slides for monitoring the IQx detection by means of MP-SPR. The SPR sensorgram shown in Fig. 1 (right side) highlights the points (1) and (2) related, respectively, to the $[Fe(CN)_5(OH_2)]^{3-}$ and $[Fe(CN)_5(IQx)]^{3-}$ complexes within the chitosan matrix.

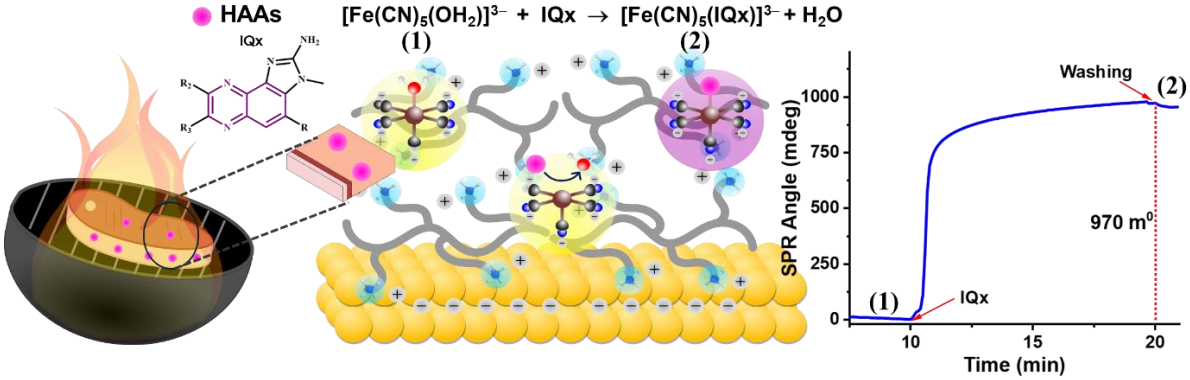

Fig. 1. Cartoon representation of the thermal generation of HAAs species, IQx planar structure, substitution reaction of H_2O by IQx within the complex adsorbed into the chitosan matrix highlighting complexes (1) and (2), and SPR sensorgram showing the $\Delta\theta_{SPR}$ associated with the coordination of IQx.

Concentrations of IQx as low as 200 µg L^{-1} were detected using CS–FeCN by means of MP-SPR. Further studies are currently under investigation to establish an analytical MP-SPR quantification methodology using the hybrid CS-FeCN material.

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