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A layer-by-layer film of chitosan in taste sensor application

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We have recently reported the use of artificial taste sensors (also called “*electronic tongues*”) in the evaluation of liquid systems throughout impedance spectroscopy [1]. As previously observed, the use of thin films aims to increase the sensitivity of polymeric devices [2]. Therefore, in this paper we describe an electronic tongue composed by a single layer-by-layer film of chitosan and polystyrene sulphonated acid (PSS). Using this technology with only a single chitosan sensing unit we could distinguish different types of red wine, with regard to their vintage, vineyard and brands.

Chitosan [$M_w = 9 \times 10^4$ g/mol (Viscometry) and $DA = 14$] was obtained from grey shrimp shells using the method described by de Bough W.A [3]. PSS (Aldrich) was used as received. Polyelectrolite solutions (1.2g/l) of chitosan and PSS were prepared in Milli-Q water at $pH = 3$ using hydrochloric acid. Three bilayers of chitosan/PSS were deposited onto a gold interdigitated structure comprising 50 digits, each having 10 μm width, 0.1 nm height, and being 10 μm apart from each other. The electrode was dipped 3 minutes in each solution, sequentially rinsing in Milli-Q water ($pH = 3$) and drying in a moderate nitrogen flow. Using a quartz substrate we could follow the deposition growth of the films by observing a linear increase up to 10 cycles of immersion throughout the UV absorption at 240 nm. This sensing unit was dipped into a flask containing 15 ml of a given wine, and AC impedance measurements were recorded with a Solartron 1260A. The electrical response of the sensor was analysed in terms of an equivalent circuit [4], with the film capacitance at 1 kHz chosen as the figure of merit. The data were processed with Principal

Component Analysis (PCA) to statistically correlate the samples, thus leading to the results shown in Figure 1.

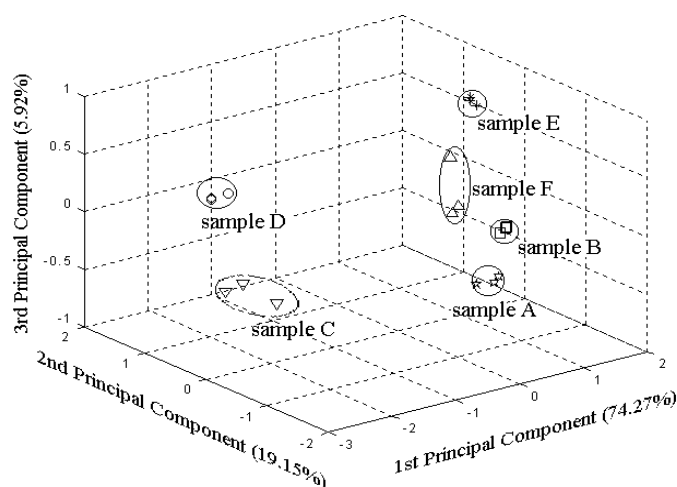


Figure 1 – PCA plot identifying red wines.

As clearly seem from Figure 1, a good distinction could be done between: i) two red wines of the same variety (Cabernet Sauvignon), same winemaker, but different vintages (1999 and 2000) – samples A and B; ii) wines of the same brand, same vintage (2000) but different grapes (Cabernet Sauvignon and Cabernet) – samples C and D; iii) good wines from table wines– samples E and F, in which sugar and conservatives were added.

Summarising, a sensor made by a single chitosan sensing unit was able to distinguish six different red wines without a pre-treatment of the samples and complex laboratory analysis. Ongoing measurements are being taken in the analysis of pollutants in liquid systems using this sort of material.

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