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Composite as a Selective Membrane for Electronic Applications

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Abstract – Selective membranes can be used in electronic devices for several reasons, such as electronic nose development. Plasma thin film composite was produced using 5 μm starch particles and fluorinated organic ether and tested for electronic applications with a quartz crystal microbalance. The film is conformal, XPS analysis shows fluorine on the surface and FTIR revealed mainly CO species, and QCM indicates adsorption of polar organic compounds. This thin film is environmentally correct and can be used not only in electronic devices such as electronic tongue, to allow adsorption, but also as protective layer, i.e. barrier to acid and basic solutions.

Electronic devices can use selective membranes for several uses, from protective layers to electronic nose development, etc. [1]. Due to the small dimension on electronic devices, these membranes must be thin, i.e. sub micrometer range, and be produced in a rough topography. With such constraints, the use of plasma deposition is a useful tool to obtain thin films that can be used as selective membranes [2].

The produce thin film as a composite of 5 mm starch particles (obtained from cassava - Manihot esculenta Crantz - tubercle) and fluorinated organic ether (methyl nonafluoro(iso)butyl ether was used as reactant). The films were deposited on silicon, for chemical analysis and piezoelectric quartz crystal for adsorption analysis. These films were analyzed using: electron microscopy, to determine step coverage, infrared (FTIR) and x-ray photoelectron (XPS) spectroscopy to evaluate chemical structures, contact angle measurements to estimate hydrophobic character and resistance to acid and basic solutions. Quartz crystal microbalance (QCM) was used to determine film behavior in liquid phase using acid and basic solutions contaminated with volatile organic components.

The film composite shows good step coverage on rough surfaces, as can be seen in Figure 1. Whereas infrared analysis showed mainly CO species, most likely due to starch presence, XPS indicates that ether surface is composed of C:N:O:F in proportion of 51:1:9:38 respectively. Contact angle measurement shows a hydrophobic surface (80º with water) and the surface can be exposed to acid and basic concentrated solutions (1M) during 5 min and 1 min, respectively, without meaningful modifications.

QCM analysis shows that, due to the starch presence, the film can adsorb polar volatile organic compounds, such as 2-propanol and Figure 2 shows typical results for thin exposed to polar and non-polar organic compounds.

This thin film is environmentally correct and can be used not only in electronic devices but also as protective layer, i.e. barrier to acid and basic solutions.

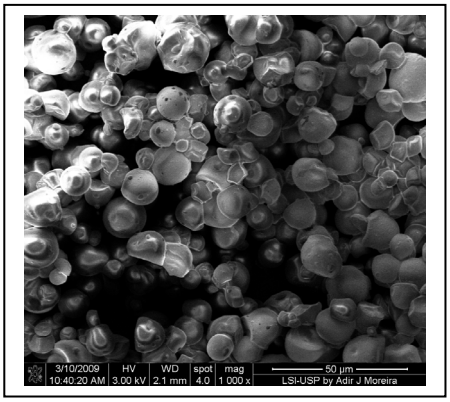

Figure 1: SEM image of starch particles and methyl nonafluoro(iso)butyl ether thin films.

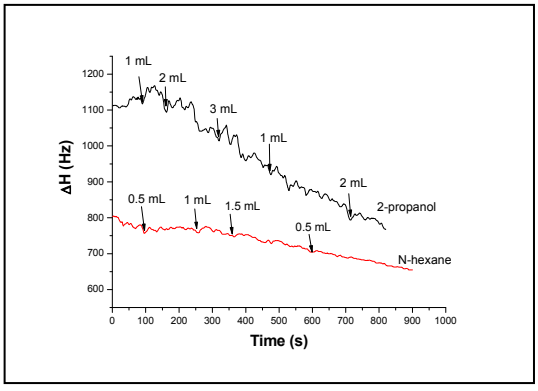

Figure 2: Typical results of the QCM for methyl nonafluoro(iso)butyl ether thin films exposed to 2-propanol and n-hexane.

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