

## Detection of ammonia and amines using polyaniline composites

Conducting polymers are very much sought in recent years due to their low cost, ease of synthesis, processing and its ability to sense in the room temperature. Polyaniline, polypyrrole, polythiophene and polyacetylene are some of the important conducting polymers exploited extensively for a variety of applications. Among these, polyaniline (PANI) is the most preferred one since it has the ability to switch between the insulating and conducting phase through an acid/base doping or dedoping process (Mac Diarmid, 2001). The aim of the study was to synthesize a polyaniline composite by introducing different amine responsive molecules. Polyaniline-curcumin-copper-cobalt (PC3) was synthesized and the composite was characterized using FTIR (Fig. 1). The FTIR evaluation exhibited the formation of the composite by showing the characteristic peaks of curcumin, copper and cobalt. The wave numbers at 488 and 543  $\text{cm}^{-1}$  highlight the presence of copper and cobalt, whereas 945, 1249, 1011, 1510, 1650  $\text{cm}^{-1}$  are due to the presence of curcumin. The characteristic peaks of polyaniline was 660, 829, 1180, 1290 and 1560  $\text{cm}^{-1}$ . There was clear shift in the peaks of designated individual molecules which showed the formation of composite. The composite was tested for the detection of ammonia, methyl, dimethyl

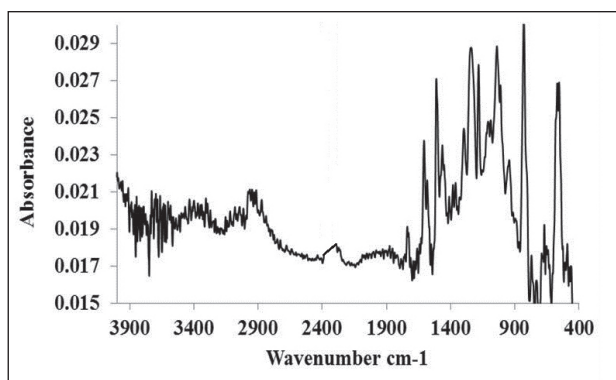


Fig. 1. FTIR spectra of polyaniline-curcumin-copper-cobalt composite

and trimethyl amines (TVBN). TVBN detection was done through cyclic voltammetry, electrochemical impedance and visual methods. The composite responded to TVBN from 1 ppm to 200 ppm by exhibiting gradation of bluish green colours with increasing concentration (Fig. 2). The nitrogen and amine molecules responded comparatively on similar pattern. The colouring intensity was increased with increasing concentrations (Fig. 3).

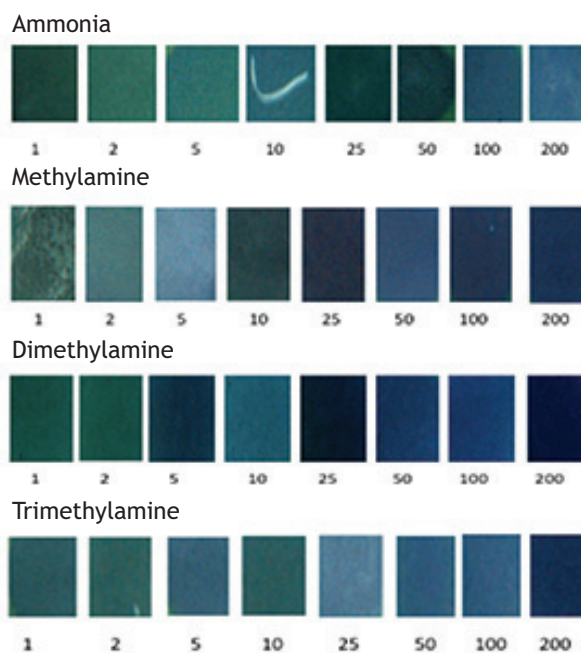


Fig. 2. Response of polyaniline composite with different concentrations (1 to 200 ppm) of ammonia, methylamine, dimethylamine and trimethylamine

Detection of very low concentration of TVBN can be carried out by cyclic voltammetric and impedance techniques. The composite was embedded over polished glassy carbon electrode and then dried. The ammonia and the amines were added into 1:1 solutions of potassium ferro and ferricyanide electrolyte and the analyte was detected electrochemically by using Pt as counter, glassy carbon electrode as working electrode and

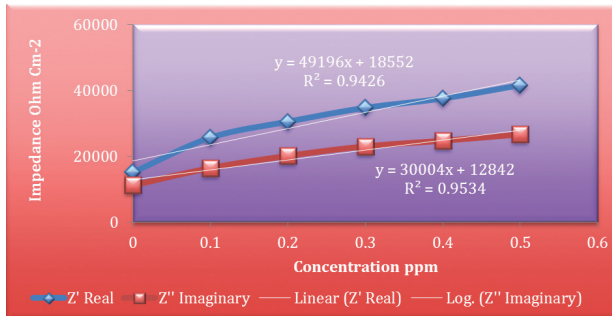


Fig 3. Electrochemical impedance spectral response of different concentrations of ammonia. The graph shows the impedance of real ( $Z'$ ) and imaginary ( $Z''$ ) with different concentrations, which followed linear relationships

Ag/AgCl electrode as reference electrode. Figure 4 shows the cyclic voltammetric pattern of methylamine in different concentrations and other amines also exhibited similar patterns. Ammonia did not respond with cyclic voltammetry since it does not undergo any oxidation and reduction reaction.

The results show that the synthesized composite is a potential candidate for the detection of ammonia, methyl, dimethyl and trimethyl amines

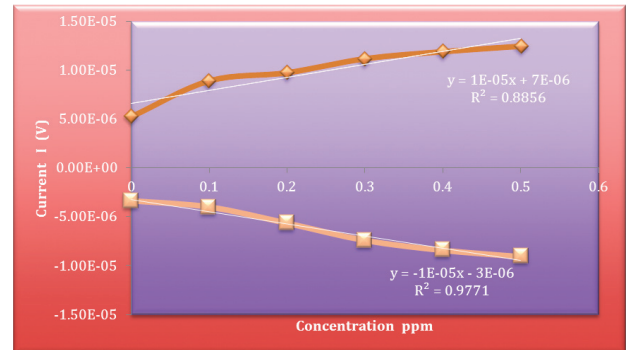


Fig. 4. Cyclic voltammogram of methylamine in different concentrations and the bottom is the peak current response at different concentrations. Upper line shows the oxidation response and the bottom due to the reduction

and the method can be utilized for the quantitative detection of fish spoilage and adulteration. The response with electrochemical technique highlights that it can be utilized for detection through electronic devices.

## Reference

Mac Diarmid, A.G. (2001) - "Synthetic metals" - A novel role for organic polymers (Nobel lecture), *Angew. Chem. Int. Ed.* **40**: 2581.

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