Palladium nanoparticles decorated MWCNTs engraved in polypyrrole matrix for the sensitive detection of hydrazine based on FOSPR

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1. Introduction

Hydrazine, a well-known reactive base and a critical reducing agent is a colorless liquid used substantially in industrial as well as in military applications [1]. Despite its acknowledged and long established applications, it is considered as a human carcinogen on minute levels of exposure through inhalation, ingestion or eye/skin contact. Hence, trace level detection of hydrazine is necessary for health safety. Various methods like liquid chromatography, spectrometry, electrochemical and optical have been reported for hydrazine sensing. We report a fiber optic SPR probe based on plasmonic property of silver thin film and palladium decorated MWCNTs engraved in polypyrrole matrix as sensing layer. Polypyrrole is a well-known conducting polymer used extensively for detection of hydrazine by charge transfer reactions leading to change in both its electrical and optical properties [2]. It also helps in attachments of Palladium-MWCNTs composite on silver coated probe. Carbon nanotubes are extensively used for decoration of metal nanoparticles for enhanced catalytic activity towards oxidation of hydrazine [3] as

$$N_2H_5^+ \rightarrow N_2 + 5H^+ + 4e^-$$

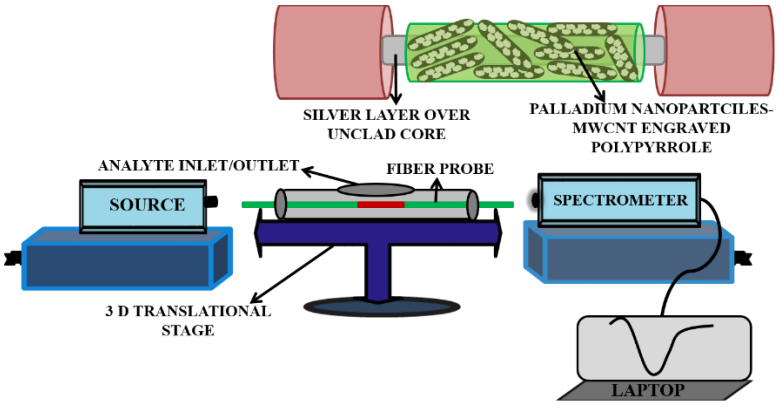

Fig.1 Schematic of experimental setup and fiber optic probe used for the detection of hydrazine.

2. Experimental and Results

The sensing setup is shown in fig.1. The fiber probe was inserted in a flow cell and polychromatic light from a tungsten halogen source was launched from one end of the fiber and the SPR spectrum was recorded at the other end using a spectrometer coupled with PC. The fiber probe was prepared by coating an unclad core of the fiber in the middle portion with silver layer using thermal deposition. The silver coated probe was then coated by dip coating method with hydrothermally prepared Pd-MWCNTs nanocomposite in polypyrrole matrix. The SPR spectra were recorded for increasing hydrazine concentration from 0 to 10 mM. Due to the use of nanopartciles we considered absorbance spectra. It was found that peak absorbance wavelength increases with the increase in the concentration of hydrazine attributing to the increase in the refractive index of the sensing layer due to the oxidation of hydrazine and adsorption of hydrogen formed on palladium nanoparticles.

References

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