Facile Preparation of Chemical Sensors Based on Carbon Nanotube Buckypapers: Preparation, Characterization and Application

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Buckypaper is thin and lightweight material which is produced through the aggregation of carbon nanotubes (CNT) from a liquid medium [1]. The preparation of a Buckypaper starts first with the dispersion of the carbon nanotubes in an appropriate medium which will eventually assist for the creation of a percolated carbon nanotube network forming the desired Buckypaper. Due to its high surface area and electrical conductivity, it has the potential to be utilized as chemical sensors for the detection of various chemicals [2]. In this work, we have focused on the parameters determining the formation of the Buckypaper with structural integrity. Within this context, different solvents and solvent mixtures are used and their effect on the carbon nanotube aggregation is studied. It was seen that the medium selected plays a vital role in the process. For instance, use of water as the sole medium induced more agglomeration whereas the use of acetone enhanced the dispersion of the CNT and produced a structurally intact Buckypaper. Moreover, the Buckypaper with the desired integrity is analysed in terms of its electrical, chemical properties and porosity. It was seen that electrical resistance is influenced by the choice of the processing medium. Sophisticated analytical tools such as X-Ray Photoelectron Spectroscopy (XPS), SEM and Raman microscopy are used to further analyse the properties. After confirming the physicochemical properties, sensor performance of the produced materials is tested. For this purpose, a nerve gas stimulant is used. The effects of sensing conditions such as temperature and humidity are assessed to fine tune the best working conditions of the sensors produced based on the Buckypaper.

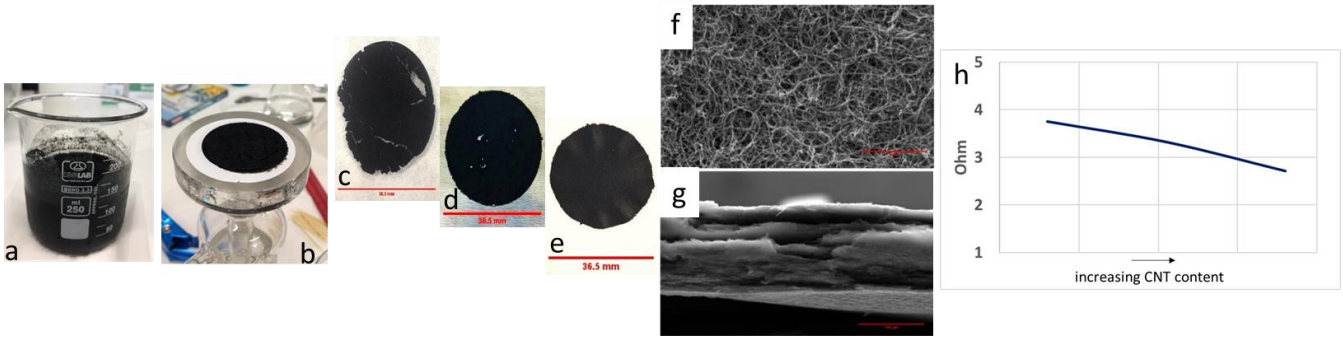

Figure 1: a) Carbon nanotubes dispersed in a medium b) Buckypaper obtained through vacuum filtration process c-d-e) examples to Buckypapers obtained by using different dispersing mediums, sample shown in e being the best in terms of physical integrity f) SEM image showing the web-like network formed by carbon nanotubes g) SEM image showing the cross-section of the Buckypaper and h) electrical resistivity measured as a function of carbon nanotube content in the Buckypaper produced.

References

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