**Carbon nanotube-cellulose ink for rapid liquid identification**

Tiago Amarante †,‡, Thiago H. R. Cunha‡, Claudio Laudares‡, Ana P. M. Barboza⁋, Ana Carolina dos Santos†,‡,Cíntia L. Pereira†,‡, Vinicius Ornelas†,‡,Bernardo R. A. Neves†, André S. Ferlauto§,‡, Rodrigo G. Lacerda†,‡\*

†Departamento de Física, Universidade Federal de Minas Gerais, Belo Horizonte - CEP 31270-901

‡CTNano-UFMG - Centro de Nanotecnologia em Nanomateriais e Grafeno, Universidade Federal de Minas Gerais, Belo Horizonte - CEP 31270-901, Belo Horizonte - CEP 31310-260

⁋Departamento de Física, Universidade Federal de Ouro Preto, Ouro Preto - CEP 35400-000

§Centro de Engenharia, Modelagem e Ciências Sociais Aplicadas, Universidade Federal do ABC, Santo André - CEP 09210-580

**Supplementary Information – part 1**

The water-based carbon nanotube (CNT) ink was produced by direct dispersing functionalized CNTs in water. The CNTs were produced by Chemical Vapor Deposition (CVD) [1] and the functionalization was carried out via a modified oxidation process as reported elsewhere [2]. The CNTs were poured in water at a concentration of 1 %(w/v) and dispersed under sonication for 3h. The resultant suspension was centrifugated until a uniform ink was obtained, with concentration varying between 0.4-0.6 %(w/v). Some characterizations of the CNTs are presented in figure S1.

Graphical user interface, application

Description automatically generated

(a)

(b)

Figure S1 – Typical morphology and characteristics of the functionalized multi-walled carbon nanotubes (MWCNTs) used in this work (a) SEM image; (b) TEM image; (c) Thermogravimetric Analyses; (d) Raman spectra; (e) CNT ink; (f) thin film SEM image from spray-deposited ink.

Further characteristics are as follows:

* Viscosity: ~ 1.0 mPa.s
* Tube diameter: 10-30 nm
* Tube Length: 1-5 µm
* Sheet resistance (10 µm - width): 103 Ω/□

**Supplementary information – part 2**

|  |  |  |
| --- | --- | --- |
| **PCA features variables** | | |
| **Variable** | **Definition** | **Algorithm** |
| *Area* | Area of gain (S) curve data | *Area = sum(S)* |
| *max* | Maximum value of the gain (S) curve | *max = max(S)* |
| *t\_max* | time corresponding to the *max* position | *tmax =time(max)* |
| *slope* | Slope of a line passing through (0,0) and (tmax, max) | *slope = max/tmax* |
| *reslope* | The *slope*^(-1) | *reslope = slope-1* |
| *maxdev* | Maximum value of the numeric differential of gain (S) curve | *maxdev = max(diff(S))* |
| *mindev* | Minimum value of the numeric differential of gain (S) curve | *mindev = min(diff(S))* |
| *ratio\_minmax* | Ratio of min\_dev and max\_dev | ratiominmax = maxdev/mindev |
| *WAHM* | Width of the curve measured at a factor of maximum λ. | WAHM = time2(max. \* λ) - time1(max. \* λ) |

[1] DA CUNHA, THIAGO H.R.; DE OLIVEIRA, SERGIO; MARTINS, ICARO L.; GERALDO, VIVIANY; MIQUITA, DOUGLAS; RAMOS, SERGIO L.M.; LACERDA, RODRIGO G.; LADEIRA, LUIZ O.; FERLAUTO, ANDRE S. High-yield synthesis of bundles of double- and triple-walled carbon nanotubes on aluminum flakes. CARBON, v. 133, p. 53-61, 2018.

[2] CASTRO, VINÍCIUS; COSTA, INGRID; LOPES, MAGNOVALDO; LAVALL, RODRIGO; FIGUEIREDO, KÁTIA; SILVA, GLAURA. Tailored Degree of Functionalization and Length Preservation of Multiwalled Carbon Nanotubes by an Optimized Acid Treatment Process. JOURNAL OF THE BRAZILIAN CHEMICAL SOCIETY, v. 28, p. 1158, 2016.