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Inkjet printing of orientated arrays of single-wall carbon nanotubes

14 - Matériaux carbonés (synthèse, caractérisation, propriétés et applications)

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Nanotube-based patterns and films have exciting potential applications in electronics and opto-electronics. One of the key issues to optimize the electrical and optical properties of nanotube arrays is the control of their orientation. So far, orientation of nanotubes in thin films was achieved i) directly during CVD growth [1], ii) using liquid dispersions: by dielectrophoresis [2], in an hydrodynamic flow [3,4], in the field of an host liquid crystal [5], by formation of a liquid crystal in concentrated suspensions [6], or iii) by stretching composites [7]. However, versatile and industry-compatible methods are still needed, and inkjet printing appears to be a good candidate. Recently, Denneulin et al. reported an heterogeneous orientation of SWNT in inkjet printed lines, with a preferential orientation parallel to the lines at the edges and perpendicular in the sub-surface [8]. On the other hand, Beyer et al. reported an homogeneous alignment parallel to the lines for inkjet printed SWNT, and assigned it to the formation of a nematic phase for special printing rates [9].

Here, we present a coupled Raman/SEM study of the alignment of SWNT during inkjet printing of aqueous suspensions as a function of temperature, nanotube concentration and printing conditions. We report a very good alignment of the nanotubes, especially at the edges of the printed patterns, and we discuss the contributions of hydrodynamics and thermodynamics to the orientation.

References

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