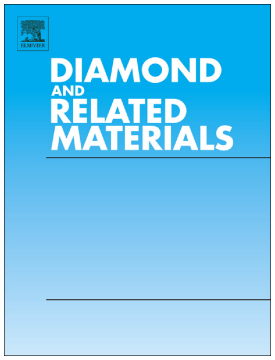

FTIR spectroscopy of nanodiamonds: Methods and interpretation

Tristan Petit, Ljiljana Puskar

PII: S0925-9635(17)30704-5
DOI: doi:10.1016/j.diamond.2018.08.005
Reference: DIAMAT 7178

To appear in: *Diamond & Related Materials*

Received date: 6 December 2017
Revised date: 20 July 2018
Accepted date: 13 August 2018

Please cite this article as: Tristan Petit, Ljiljana Puskar , FTIR spectroscopy of nanodiamonds: Methods and interpretation. Diamat (2018), doi:10.1016/j.diamond.2018.08.005

FTIR spectroscopy of nanodiamonds: Methods and Interpretation

Tristan Petit, Ljiljana Puskar

Institute of Methods for Materials Development, Helmholtz Zentrum Berlin für Materialien und Energie GmbH, Albert-Einstein-Strasse 15, 12489 Berlin, Germany

Email: tristan.petit@helmholtz-berlin.de, ljiljana.puskar@helmholtz-berlin.de

Keywords: FTIR, nanodiamonds, surface chemistry, *in situ* spectroscopy, ATR, DRIFT

Abstract

Fourier transform infrared spectroscopy (FTIR) is highly sensitive to the surface chemistry of nanodiamonds. In this review, we discuss the different FTIR methods available to characterize nanodiamonds and highlight their advantages and limitations. We also summarize the possible assignments of FTIR spectra of nanodiamonds reported in the literature and discuss FTIR spectra of nanodiamonds modified by different surface treatments. Current work of FTIR applied to *in situ* and *operando* characterization of nanodiamonds, in particular nanodiamonds exposed to water or characterized during electrochemical and photocatalytic processes, are also discussed. Finally, perspectives regarding possible future FTIR development for nanodiamonds characterization are proposed.

1. Introduction

One of the key features of nanodiamonds (NDs), as compared to many other nanoparticles, is their rich surface chemistry that can open wide possibilities for functionalization or fine-tuning of their chemical and electronic properties. In addition to the stability, biocompatibility and fluorescence properties of the diamond core, surface properties of NDs have enabled the development of medical, tribology, catalytic or sensing applications.[1–3] To this aim, the reliable characterization of NDs surface chemistry is essential.

Fourier Transform Infrared (FTIR) spectroscopy has been employed extensively for the characterization of NDs over the last 20 years. The high sensitivity of FTIR to the surface functional groups of NDs, its non-destructive nature and generally easy sample preparation have contributed to establish FTIR as a reference method for the characterization of NDs surface chemistry. The versatility of FTIR in terms of experimental schemes applied to nanoparticles makes FTIR a method of choice for measurements from routine control of surface functionalization to advanced *operando* measurement of complex chemical processes. Some of the work on the characterisation of nanoparticles, their surface reactions and application to catalysis reactions using different modes of infrared spectroscopy has been highlighted in recent reviews.[4–6]

Interpretation of FTIR spectra is however not an easy task because the high sensitivity of FTIR to chemical environment imply that FTIR spectra is also very sensitive to experimental conditions (sample preparation, atmosphere...). Contrary to electron and X-ray spectroscopies, FTIR is not element-specific and different chemical bonds may have IR-active vibrational modes at the same