Raman spectroscopy elucidates the transformation of single-walled carbon nanotubes following abrasive wear of epoxy coatings

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1. Introduction

Nanomaterials are integrated into consumer products to enhance specific properties [1]. However, concerns arise regarding their eventual release throughout the product lifecycle, particularly due to mechanical strains that can result in the generation of fragmented materials of **particulate matter (especially PM2.5)** or even nanomaterials. In this study, we investigated the potential release of single-walled carbon nanotubes (SWCNTs - brand TUBALL™) from epoxy composite materials. We utilized a pin-on-disk type tribometer to simulate accelerated mechanical aging of the nanocomposites (figure 1).

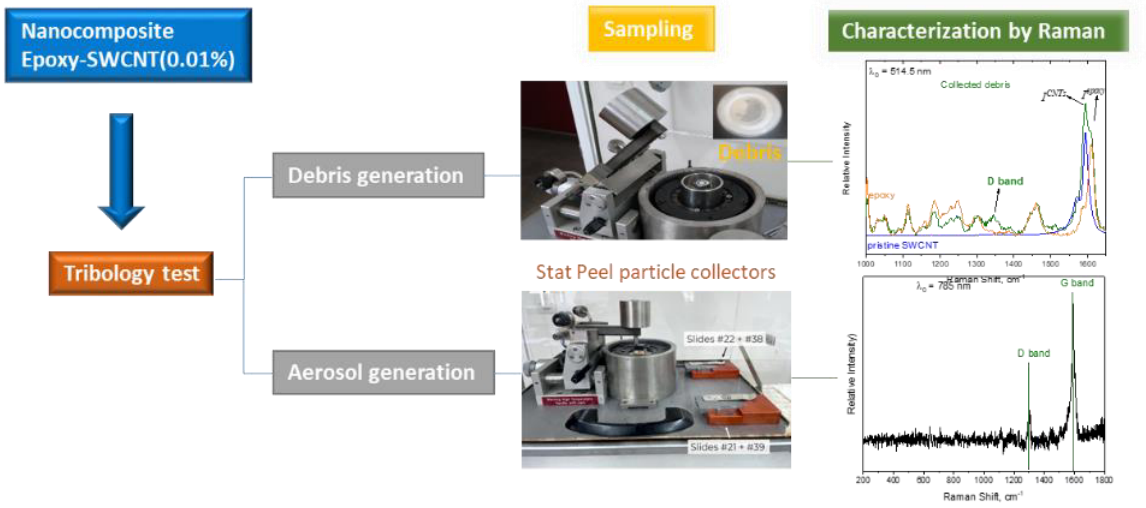

Figure 1: ***Schematic representation of experimental setup used.***

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2. Results

Raman spectroscopy was used to characterize pristine nanocomposite material, abraded material, and debris obtained from the tribometer, while airborne particles generated during the abrasion test were collected using the Stat Peel's Identifier C2 system (figure 2).

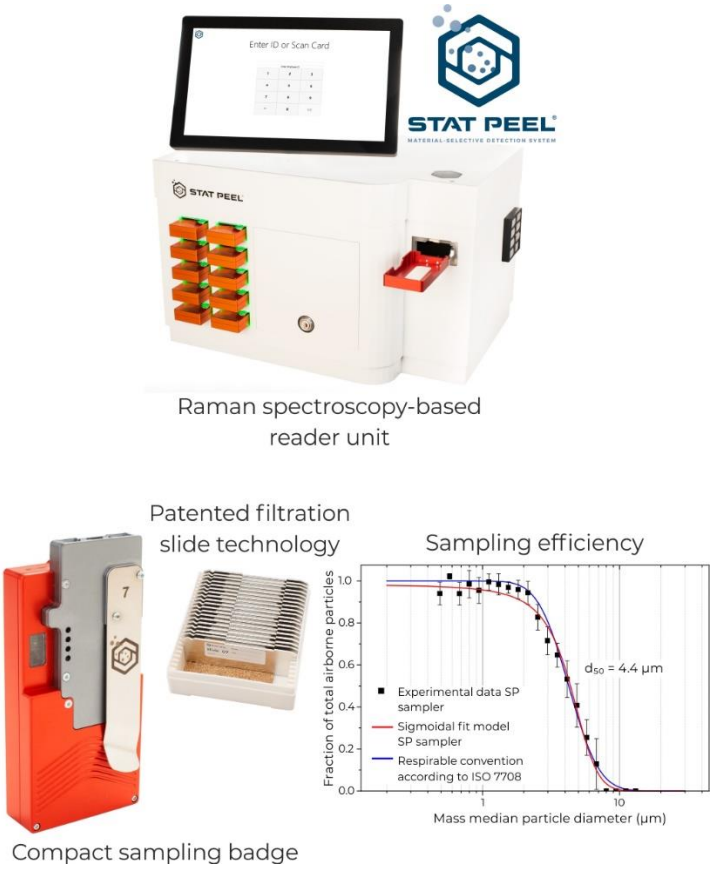

*Figure 2: **STAT PEEL Identifier system.***

3. Conclusions

Raman spectra conducted on the Stat Peel filters revealed the presence of free SWCNTs released from the epoxy matrix, albeit in notably low quantities. All the SWCNT quantified masses are close to the LoQ of the system and the calculated exposures are three orders of magnitude lower than the NIOSH recommended exposure limit (REL) of 1 µg/m^3. Evidence of structural changes and degradation in SWCNTs within samples subjected to accelerated wear during abrasive tests was readily discernible in the Raman spectra proved by the intensity of the characteristic band associated with defects, D-band, in the nanotubes [2].

4. References

[1] [1] F. Hussain, M. Hojjati, M. Okamoto and R. Gorga, Journal of Composite Materials, **2006**, 1, 20-22.

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